Assessing the success of on-farm conservation projects in delivering conservation and livelihood outcomes: Identifying best practices and decision support tools

THE McKNIGHT FOUNDATION

Final Technical Report
(March 2010 - November 2012)

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I. *Overview*

Many projects have been and continue to be implemented worldwide to support on-farm conservation of agricultural biodiversity and the use of this diversity (through the mechanisms of markets, nutrition and ecosystem services) to improve human well-being. These projects, mainly supported by international organizations, have on-farm conservation either as their specific focus or as a major component of a broader focus. Yet there is a lack of systematic evaluation of the success of on-farm conservation projects in producing outcomes that maintain crop diversity on-farm and that create livelihood benefits for farmers in the form of improved income options, better nutrition, reduced vulnerability and improved ecosystem services. As on-farm conservation projects are implemented and new projects are designed, donors, policymakers and practitioners need to have the conceptual and methodological tools to assess the success of their projects and the lessons learned, and hence their investments.

This research proposes a framework to determine the extent to which on-farm conservation projects deliver livelihood and conservation outcomes. The framework aims to be an organizational tool akin to the Sustainable Livelihoods Framework and will be used to classify variables, processes and their relationships. Its use in analyses of projects will ensure that these variables, processes and inter-relationships have been considered.

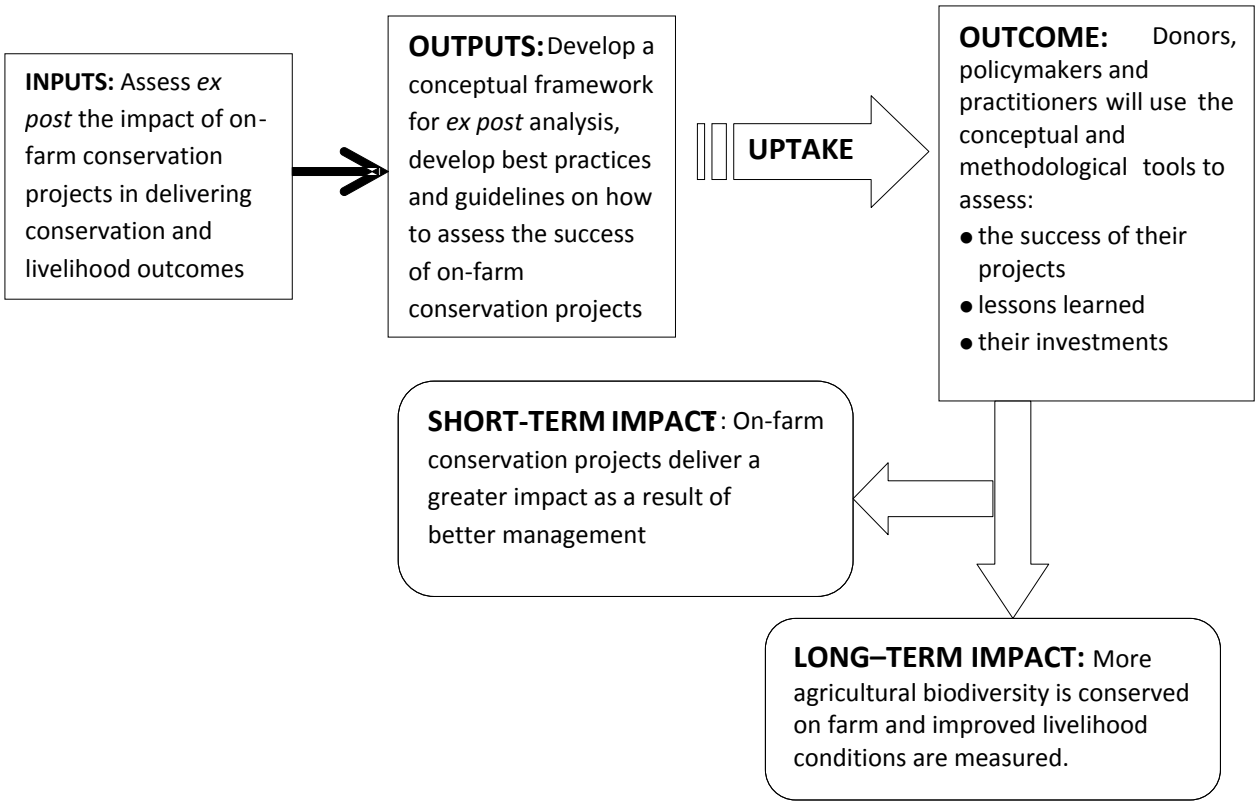
The overall goal of this project is to strengthen the contribution of on-farm conservation projects to improvements in livelihoods and food security in poor and/or marginal areas. The specific objective is to improve the ability of donors, policymakers and practitioners to assess the extent to which on-farm conservation projects have contributed to increased diversity on farm and to the creation of livelihood benefits that in turn encourage farmers to conserve diversity, creating a feedback loop that ensures both diversity and its continuing benefit to present and future generations

Throughout the dissemination of the project outputs we aim to change the level of awareness among donors, policymakers and practitioners regarding on-farm conservation projects. In the next five years we hope to see an uptake of *ex ante* analysis by project coordinators, and that appropriate indicators will be used in order to ensure a meaningful impact analysis.

This report, based on the project's findings, partially described in the 2011 annual report, will address the following questions:

1. How can we effectively assess the success of research and development on-farm conservation projects in delivering conservation and livelihood outcomes?
2. What indicators are most likely to contribute to conduct good *ex ante*, monitoring and evaluation and *ex post* analysis?
3. What data should we collect?
4. How do we deal with externalities and data imperfection?

The following diagram illustrates the impact pathway of this project (see overleaf).



On-farm conservation projects can be implemented around the world where there are areas of high levels of diversity of global significance, diversified livelihood strategies, intensive use of agricultural biodiversity and high cultural diversity. These on-farm conservation projects, if well designed and successful, should produce a positive cycle of increased diversity and improved well-being, resulting in the maintenance of or increase in diversity while simultaneously reducing poverty.

Both the qualitative and the quantitative analyses carried out during the grant demonstrated that on-farm conservation interventions supporting on-farm management of native crop diversity are largely successful and accomplish their objectives in a cost-effective manner. ***The results produced by the grant strongly suggest that adoption of the innovations from on-farm interventions has an effect on the relevant biodiversity and that the relevant biodiversity in turn has an impact on livelihoods.***

II. *Narrative*

A. *Activities*

In the first year of project implementation, a literature review was conducted to examine a set of on-farm conservation projects that support on-farm management of native crop diversity and seek to increase livelihood benefits derived from this diversity. Six case studies funded by the McKnight Foundation and other donors were selected from these projects (Appendix A, Table 1). During the grant's second year the team focused on assessing the impact of this sample of specific on-farm conservation projects and then developed a set of conceptual and methodological tools to design on-farm conservation projects to deliver impact and measure it. In April 2012 an end of project meeting in Rome brought together representatives from the institutions implementing the six projects that constituted the case studies and external experts to discuss the overall results and the methodological and policy implications. The project, due to end in February 2012, was ultimately extended until the end

of November 2012. Please see Section II. C. of this document for further information and the accompanying Final Financial Report budget narrative for commentary on how this was reflected in the budget expenditure. In this last phase of the project, Dr Mauricio Bellon was able to attend the McKnight Foundation's Community of Practice meeting in Ecuador in July 2012, which provided an opportunity to share insights from the project with other McKnight beneficiaries and peers. A number of dissemination materials and peer-reviewed papers were also developed to share valuable insights and key methods from the project.

a) **Model for assessing success**. A simple model was developed to assess the success of on-farm conservation projects. The model identified three areas that need to be addressed: (1) the relevant components and their respective levels of biodiversity maintained in an agricultural system (referred to as agricultural biodiversity), (2) the private benefits that farmers and their households derive from that agricultural system (referred to as livelihood benefits), and (3) the public benefits that society derives from the relevant components of biodiversity maintained in an agricultural system (referred to as societal benefits). The model indicated that in order to assess success of an on-farm conservation project three questions need to be answered: (1) Do farmers apply the innovations provided by project interventions? (2) If so, does the application of these interventions lead to farmers maintaining higher levels of native crop diversity than would have been maintained without them? (3) Does this higher level of native crop diversity lead to increased well-being among farmers who applied the interventions? A positive answer to these three questions indicates that a project was successful. Based on this, an econometric approach was developed to answer these questions in the context of the six projects studied. A summary of the model is provided in the factsheet "A Conceptual Framework for On-Farm Conservation Projects" (Appendix H)

b) **Network analysis.** Given that projects take place in the context of networks of actors and hence project outputs and outcomes result from interactions in such networks, we carried out a network analysis for each project. A network analysis uses a methodology that maps out the actors, their goals, links and influence, and from this obtains a series of parameters that characterize the network structure and function. From the project reports, all actors and their linkages were identified, from which their interactions were mapped. A survey with project leaders was used to validate and complement the information on the actors involved and to probe for missing information, particularly regarding the types of interaction between the implementing organization and the different actors, and the services that were given and received in the interactions among them, e.g. funding, research results, training and exchange of relevant information related to the project (dissemination). Based on these data, we identified: (a) the role of each actor in the network and their contribution; and (b) their influence on the implementation of the project. Influence was measured by asking project leaders to rate the intensity of the relationship among actors in the development and implementation of the project on a scale of 1 to 4 (lowest to highest). From this information we calculated two network parameters[1]: (1) degree centrality, and (2) betweenness. Degree centrality is the number of other actors an actor is adjacent to and hence represents how well-connected that person is to others directly (ignoring indirect links),which in turn can be divided into in-degree centrality, which counts the in-going links, and out-degree centrality, which counts the out-going links. Betweenness refers to the

[1] A third parameter, closeness centrality, which measures how close is an actor to any other in the network—being globally central if it lies in the shortest paths to many other—was not calculated because our data are based on the perspectives of the implementing organizations, lacking the perspectives of the other actors in the networks, hence this parameter if calculated would have been an artifact of the way data were collected.

level to which an actor is an intermediary between two other actors inside a group; it measures how often an actor lies on the shortest path between others, i.e. if A has to go through B to get to C, B has a high betweeness score. The network analysis was carried out with the NetMap Toolbox adapted to our case studies (http://netmap.worldpress.com/). To visualize and analyze the network we used the software SocioMetrica VisuaLyzer 2.0, which has been designed to graphically display small- and mid-sized networks. A summary of the analysis is provided in the factsheet "Network Analysis for Evaluating On-Farm Conservation Projects" .(Appendix H)

c) **Field surveys.** For the six case studies identified during year 1, further field studies were carried out to obtain a quantitative assessment of the implementation and outcomes of the projects. These included focus group discussions and a household-level questionnaire with a sample of project participants and non-participants in the project implementation areas. The questionnaire elicited information on: (1) family demographics, education, occupations, and migration; (2) land tenure, landholdings and plot quality; (3) gender; (4) animal holdings and ownership of agricultural assets; (5) access to information and social networks; (6) participation in government and non-governmental programmes and (7) housing and access to public infrastructure. For each project, the specific interventions had been previously identified. Information on participation in the interventions was compiled in a form noting whether or not they were applied, and if so, rating their usefulness. In addition and depending on the nature of the project, there were specific forms for crop diversity, crop consumption, crop management and perceptions of well-being. These modules were adjusted according to the diversity and livelihood outcomes that each project aimed to achieve. The questionnaire included information on several socio-economic, locational and environmental confounding factors that were used to correct for observed differences[2] among the two groups. The sampling framework had to be adjusted to the conditions of implementation of each project, since each project had its own characteristics. Table 5 in Appendix A presents the specific sampling used in each project, including the sample size and the number of villages where the studies took place. In five of the six cases, the sample was drawn randomly from two populations: participants and non-participants in the projects in the sites where they took place. In one case, the sample was drawn randomly from the population in the area where the project took place without *a priori* distinction between participants and non-participants. The samples are representative of the population for the project sites, though the scale varied by project, but they vary in size, proportion of sample relative to the population and proportion of participant and non-participant households.

d) **Statistical analyses.** The statistical analysis comprised two components. One was a descriptive analysis based on the surveys, characterizing the households in the sample in socio-economic terms by reporting frequencies, means and standard deviations of key relevant variables. This analysis also paid particular attention to the interventions undertaken by each of the projects, the rates of participation, adoption and how interventions were evaluated by farmers. Also, through interviews with project leaders, it was established whether or not each intervention could be attributed to the projects, either because other projects in the area promoted the same type of intervention or because the intervention consisted of disseminating existing local practices to a wider, local audience. The second component involved an econometric analysis of the extent to which there was participation in project activities, the evaluation by participants of the usefulness of the interventions and an examination of how the application of these interventions in the field influenced observed patterns of management and use of native varieties and species. Further

[2] Clearly we are not able to control for unobserved difference and this is a limitation of this study.

analysis then sought to determine the extent to which these factors in turn influenced perceived benefits associated with the native diversity. The exercise corrected for a set of confounding variables and for potential biases.

In order to carry out the **econometric analysis**, a set of indicators was developed for three different outcomes: (a) adoption of innovations provided by project interventions, (b) crop diversity and (c) benefits associated with household well-being. In the case of the six projects analyzed, and because project interventions were not assigned randomly between treatment and control groups, there were no *a priori* control groups and no baseline available, an instrumental variable method had to be used to analyze whether these projects can be deemed successful or not. To address the complexity of assessing three different outcomes, a simultaneous equations system was estimated, including other determinants of participation and outcomes of interest. These variables include several socio-economic characteristics of the sample, the environment and household location (the confounding factors) and they can be considered fully exogenous, not being affected by participation. Since project interventions were many and comprise multiple aims, that is, a "basket" of research-based and development-oriented activities, the indicator used is the number of interventions adopted (applied) by a household. For crop diversity, the indicator was derived from the number of varieties of target crops planted by households in each project, a measure of crop richness. Since in all projects there were multiple target crops, a factor analysis was performed on the number of varieties of each target crop per household in order to obtain a reliable univariate measure of crop diversity. For household benefits in most projects, the indicator was the quantity (weight) of target crops produced, consumed and marketed by the household. If prices were available, we calculated the gross revenues from marketing. In one project however, the indicator was a life satisfaction index derived from a series of ratings on the level of satisfaction experienced by the household with respect to different variables such as housing, access to education, economic activities, social life and contacts, as well as nutrition and food security. A summary of the methods used is provided in the factsheet "Methodologies for Evaluating On-Farm Conservation Projects" (Appendix H)

B. Results

Network analysis. From the network analysis we gathered some interesting insights into the types of partnerships and actors involved in the six on-farm conservation projects we analyzed in the Andean region (Table 4 in Appendix A; factsheet "Network Analysis for Evaluating On-Farm Conservation Projects", Appendix H).

Network centrality differs from project to project, however it is rather high both in degree and betweenness. Most project activities are developed by the implementing institution with few key partners, usually in a centralized network with one or two focal points.

The type of link prevailing in the network is "exchange of information": dissemination activities were in fact carried out by all projects and include both sharing information with single institutions and organizations, and promotion events that link different actors. Research-for-development projects seem to focus on research activities with universities and private institutions, while projects aimed at rural development focus on training activities and dissemination of information.

Interventions—participation, assessment and application: Tables 6 and 7 in Appendix A present the results in terms of participation and adoption of innovations provided by interventions among the six projects studied. Each project implemented between 13 and 22 interventions, and the results show that

Adoption		**0.2889878** *	
Native Crop Diversity			467.9104
		Bolivia[1]	
Ex ante participation	**1.908434** ****		
Adoption		**0.0337049** ****	
Native Crop Diversity			**497.0055** ****

Note: *, **, ***, ****, significant at the .10, .05, .01, .001 level respectively

[1] The two projects in Bolivia, SINARGEEA and Bioversity/PROINPA were merged because they included very similar interventions, were implemented by the same institution PROINPA. A dummy variable was added to take into account project-based differences.

[2] In the case of INIAP, the sample was not stratified by *ex ante* participation due to lack of available information. However, discussions with implementers indicated that being part of a protestant church played a key role in participation, so a response mentioning a church in the section on social organization was used as the instrument for the adoption equation.

Two papers have been produced for a scientific audience. One presents the conceptual framework used and the other the empirical evidence from the econometric results. (Appendices H & I)

C. Challenges

Network analysis. Ideally, the data needed for a network analysis should be compiled in a participatory process that involves all actors and captures their different perspectives; however, due to time and funding constraints, the data were only elicited from project reports and a survey of project leaders[3].

Interventions—participation, assessment and application. An important challenge was to conceptualize what an "intervention" means in a way that can be made operational and analyzed. At the beginning we were using the idea of intervention ambiguously, conflating activities and outputs, leading to confusion in the analysis. Conceptually we defined interventions as activities carried out by a project that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity. This definition improved our capacity to articulate and analyze our hypotheses about project success.

Statistical analysis. Unfortunately, no baseline (or end line) data were available for the studies, nor were there any control sites (similar sites to the intervention sites but where no project activities were carried out except for baseline and end line surveys). Participants and non-participants were randomly selected from the interventions sites, the latter to serve as "controls". We are keenly aware of the limitations of this approach (potential lack of comparability between participants and non-participants and hence biases in the results), however given the limitations of the studies, this was the most feasible approach available and we tried to correct for biases through the use of econometric techniques.

[3] This is a limitation of our approach since the analysis is based mainly on the perspective of one actor, which may overestimate their own links to other actors since they know their own links better than other actors. In spite of this limitation, the network analysis can provide useful insights into how the projects were implemented and the outcomes they delivered.

The project team, led by its enthusiasm in carrying out the analyses, decided to increase both the inputs and the outputs of the project by doubling the number of case studies examined from three to six and by adding an examination of all six case studies through the lens of network analysis. A no-cost extension to the grant was requested for two months from March to the end of April 2012, and approved in order to allow ample time to investigate all six case studies and to accommodate the needs of the network analysis of all the projects. The final workshop of the grant was postponed to April 2012 to allow the participation of the key impact specialist in the project following her maternity leave, so that the final workshop and the outputs that emerged from it could benefit from her expertise A further no cost extension was granted from May to the end of November 2012 to enable the team to produce four factsheets that summarize key methods and results for training purposes and for dissemination to policymakers, donors, researchers, practitioners and other interested parties.

D. Insights and lessons

Network analysis. A very important lesson from our study is related to partnerships. During our work we decided to add to the original grant a network analysis to understand the role of partnerships in the six case studies. This exercise was important to determine whether understanding network structure, depicting the degree of actors' interactions, their role in influencing and determining the final results, and assessing any transfer of knowledge and capacity from the implementers to the local community is a crucial exercise for determining the real impact of any research-for-development project. Moreover, network analysis is usually carried out *ex ante* to understand potential bottlenecks or collaborative links, but we conceived a new way of using network analysis for *ex post* evaluation to understand what worked, what didn't and why. To this end, we developed a small set of questions that the projects should address in order to develop a good *ex ante* and *ex post* network analysis.

Interventions: participation, assessment and application: One of the main lessons learned from our study concerns the lack of systematic assessment and definition of interventions in the context of a specific project**.** There are in fact some fundamental questions that implementers should address in designing their intervention, which seem to be generally overlooked. These questions include:

- What is an intervention? (i.e. what are the activities to be carried out? What are the innovations that these activities will provide?)
- Why is there a need for this intervention? Are we doing the right and relevant thing?
- What is the change that this intervention will bring about or what will the effect of the intervention be? (i.e. what is the expected result from the application of the innovation that the intervention provides?)
- How will the intervention bring about this change or effect? (how will the intervention and associated innovation generate the envisaged change?)

This has a dual nature: on one side, it concerns defining what the intervention is and why one wants to implement it; on the other, it involves defining the expectations that one has regarding the effects that participating in the intervention will have for the beneficiaries.

This exercise should be undertaken thoroughly at the beginning of any project because defining what one expects from an intervention automatically involves defining the instruments through which one

can achieve this expectation and the indicators of change/progress through which one measures the success of an intervention.

Moreover, there is a strong problem of attribution: it is difficult to understand what the effects of the intervention itself are and what would have happened anyway because of an existing trend. The relevant overall questions are:

- What would/would not happen without the intervention?
- Are we introducing something completely new with the intervention or are we creating new ways of disseminating or using existing practices?

The answers to these questions determine different methodologies and different evaluation methods and therefore they need to be properly addressed. Beneficiaries participate in an intervention to which they attach a certain level of usefulness and then some of them apply the innovation provided by the intervention. The rating of usefulness codetermines the rate of application. There might be spillovers to non-participants who deem the intervention useful and decide to apply the innovations learned by participants. Finally, the application of innovations determines changes in local agricultural biodiversity while it also determines changes in livelihoods both directly and through changes in agricultural biodiversity. Related to participation and usefulness, it was interesting to see that participants and implementers mainly deemed useful the same activities. There seems to be a good understanding of what farmers need and value. We also learned that the definition of a baseline and control group is fundamental to understand unambiguously the change brought about by an intervention.

Statistical analysis. Our approach has established a plausible link between the application of interventions promoted by projects aimed at on-farm conservation—even if their application was determined by factors other than project participation—and crop diversity, and from the latter to household benefits in at least in three of the projects studied. In any case, most of the project interventions would not have been available without the projects being implemented in the study communities. Furthermore, we observed an incremental response between the level of application of project interventions (each additional application of an intervention had a positive effect on the level of crop diversity) and the level of native crop diversity and between the level of diversity and the indicator of well-being, providing additional evidence of the plausibility of these links. While we may not have been able to establish exactly which interventions may have been more influential than others, it is not clear whether an assessment by individual intervention or type may be meaningful if there are interactions among interventions and hence there are systemic rather than individual effects. This is beyond the current scope of this report, but merits further attention in the future.

In spite of the limitations, our approach has provided a conceptual framework to guide what to measure and what links to test to assess empirically the plausibility of the success of an on-farm conservation project—not a small feat given the complexity of the processes analyzed and the limitations of the data available.

Guidelines for project design: Based on the learning generated by the project we created a set of guidelines to analyze project design in a systematic way. These guidelines should assist the project implementer in formulating, step by step, a sound and solid theory of change that will lead to the achievement of impact. The guidelines address: (1) targeting of project location; (2) collection of diagnostic data; (3) assessment of potential for success; (4) identification of interventions to implement; (5) definition of expected outputs, methodology and partnerships; (6) mapping of the impact pathway; (7) participatory planning and implementation; (8) collection of baseline data; (9) translation of outputs

into outcomes; and (10) assessing impact. The factsheet "Guidelines and Best Practices for On-Farm Conservation Projects: Designing and Evaluating Interventions" describes these guidelines (Appendix H).

E. Conclusions

Whilst on-farm conservation has been the focus of much research worldwide, there has been a lack of tools to enable donors, practitioners and policy makers to systematically evaluate a project's success in producing outcomes that maintain on-farm diversity and create livelihood incentives for farmers to do so. We believe this project has made significant inroads into providing such tools.

The project set out to conduct a serious analysis - the first of its kind - of on-farm conservation interventions in the High Andes region and develop the conceptual framework, methodologies and guidelines to measure impact in three areas: delivering conservation of agricultural biodiversity, delivering livelihood benefits for farmers, and delivering wider public benefits. We were encouraged to find that the majority of projects assessed as part of the project successfully delivered both conservation and livelihood outcomes for target groups, and that in particular, there was evidence that increased agricultural biodiversity leads to more livelihood benefits for farmers.

One of the major contributions of this project is the mixed methods approach, which, when applied, captures the complexity of research-based and development-oriented interventions that promote the use and conservation of native crop diversity to improve farmers' well-being. The results, while assessing ex post the success of six projects in the Andean region, also emphasize the importance of ex ante analysis to ensure the achievement of outcomes and thus a sound ex post analysis and to draw a number of lessons that can be applicable on a global scale.

The goal of implementing a multi-faceted basket of interventions with different aims is to provide diverse and relevant "options" to farmers that enhance the value of what they already have. In this regard, it is crucial to identify, develop and offer new ways of cultivating, consuming, processing and marketing the diversity of crops they have as a way to enhance farmers' choices and well-being by improving their capacities and influencing the institutional environment by providing interventions that enable choice.

Other important contributions of the project include the application of the conceptual framework, the taxonomy of potential routes of implementation and the resulting guidelines. It was demonstrated that on-farm conservation projects can be implemented around the world in areas where there are areas of high levels of diversity of global significance, diversified livelihood strategies, intensive use of agro-biodiversity, and high cultural diversity. These on-farm conservation projects, if well-designed and successful, should produce a virtuous cycle of increased diversity and improved well-being, resulting in the maintenance of or increase in diversity while simultaneously reducing poverty.

Both the qualitative and the quantitative analyses carried out during the grant demonstrated that on-farm conservation interventions supporting on-farm management of native crop diversity are largely successful and accomplish their objectives in a cost-effective manner. The results produced by the grant strongly suggest that adoption of the best practices from on-farm interventions has an effect on the relevant biodiversity and that the relevant biodiversity in turn has an impact on livelihoods.

IV. Appendixes

All Appendixes are separate files.

Appendix A: Research Report (Figures and Graphs in Annex)

Appendix B: Publications Summary & Training and Outreach Summary

Appendix C: Theory of Change (information included within Appendix A, p 6)

Appendix D: Monitoring and Evaluation Plan (information included within Appendix A)

Appendix E. Research Questions and Protocols (information included within Appendix A, pp 4-6)

Appendix F: Data and Document Store and Data Sharing Plans. *All documents and data are available in electronic form and have been indexed. The documents are in WORD and the data are in Excel and STATA formats. The plan is to make the data publicly available in two years, so that it can be analyzed further by the team to produce additional publications.*

Appendix G: Full report from the literature review

Appendix H: Four factsheets with key methods and results from the project in English and Spanish

Appendix I: Conserving landraces, improving livelihoods: A framework for assessing the success of on-farm conservation projects (scientific paper under submission, *separate file*)

Appendix J: Assessing the contribution of on-farm conservation projects of crop biodiversity to resilient agricultural and food systems. Evidence from the High Andes of South America (draft scientific paper, *separate file*).

Assessing the success of on-farm conservation projects in delivering conservation and livelihood outcomes: Identifying best practices and decision support tools

THE McKNIGHT FOUNDATION

Final Technical Report
(March 2010 - November 2012)

Appendix A: Research Report

Submitted to the McKnight Foundation by Bioversity International
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Appendix A: Research Report

Assessing the success of on-farm conservation projects in delivering conservation and livelihood outcomes: Identifying best practices and decision support tools

Research Report to the McKnight Foundation

December 2012

Contents

I. Introduction, Research Design and Conceptual Framework

The diversity of cultivated plant species and domesticated animal breeds has been and continues to be the basis of our food supply and good nutrition. This is equally true of subsistence-based societies and technologically advanced societies. These plant and animal resources provide numerous benefits that include a diversity of foods and income opportunities (Love and Spanner 2007). They are particularly important for diversified and nutritious diets, as well as for the genetic resources that allow farmers and plant breeders to adapt a crop to heterogeneous and changing environments (Fowler and Hodgkin 2004), an issue particularly important under the pressures of climate change. Another important benefit is the provision of certain ecosystem services such as resilience, less agrochemicals, disease and pest resistance, soil health and water conservation in specific situations (Hajjar et al. 2008).

Definition: On-farm conservation

Refers to maintaining in the field the evolutionary processes that generate new potentially useful genetic variation in crops. This involves farmers' continued cultivation and management of a diverse set of crop populations in the agro-ecosystems where the crop evolved or in secondary centers of diversity. It depends on the active participation of farmers and the existence of incentives for them to do so.

This diversity is a key asset of the rural poor in developing countries that depend on agriculture for their livelihoods and well-being (Jarvis et al. 2008). The loss of crop and livestock diversity has been recognized for many decades as a major problem (Harlan, 1992; Hawkes, 1983), particularly in centers of domestication and diversity such as the Andean region (Ortega 1997). Efforts to conserve crop diversity have led to the collection and conservation of seeds in genebanks, i.e. *ex situ* conservation (Plucknett et al. 1987). In the last two decades there has been a growing interest in the use and management of agricultural diversity in farmers' fields and in the wild (i.e. on-farm and *in situ* conservation) as a complementary strategy to *ex situ* conservation (Brush 2004; Bretting and Duvick 1997). On-farm conservation involves farmers' continued cultivation and management of a diverse set of crop populations in the agroecosystem where the crop evolved or in secondary centers of diversity and depends on farmers' active participation based on farmers' reasons and incentives for maintaining diversity (Bellon et al. 1997).

Maintaining crop diversity on-farm can entail important costs to farmers, often in the face of strong incentives to abandon this diversity -- hence the need for interventions to support farmers in maintaining this diversity (Bellon 2004). **The basic principle of any on-farm conservation intervention is not to keep farmers poor but to enable them to capture more benefits from the diversity they maintain**, including those benefits associated with the often significant public good values resulting from that conservation. Such public good values can include not only the conservation of the genetic resource itself, but also the provision of socio-cultural and environmental services (e.g. maintenance of local culture/traditions and landscapes) (Lipper and Cooper 2009). The challenge of any on-farm conservation project is to identify, design and implement interventions that make the conservation of crop diversity on-farm compatible with improved livelihoods and wellbeing among the farmers who conserve it (Bellon 2004). The aim is to maintain diversity while reducing poverty.

Many projects have been and continue to be implemented worldwide to support on-farm conservation, either as their specific focus or as a strong component of a broader focus, mainly supported by international organizations (Jarvis et al. 2004). These projects have yielded important insights into the role of farmers in the process, their reasons for maintaining crop diversity on-farm

and the threats they face, as well as having piloted numerous interventions such as seed fairs, participatory evaluation of landraces and dissemination of seeds, biodiversity registrars, improved marketing, participatory crop improvement, etc. (e.g. Bellon et al. 2004; Jarvis et al. 2000; Milpa Project 1999). However, there is a lack of tools that enable donors, practitioners and policy makers to measure a project's success and therefore there has been very little systematic evaluation of the extent to which these projects have actually produced on-farm conservation outcomes in terms of maintaining or increasing crop diversity on-farm—including farmers' knowledge and practices that underpin this diversity—as well as of livelihood outcomes that create benefits for farmers. This lack of systematic evaluation of project outcomes hampers the ability of donors, policy-makers and practitioners to learn and improve from their experiences and may lead to an inefficient use of scarce resources, not only by donors and practitioners, but also by participating farmers. Evaluating these projects, however, presents some important methodological challenges that have received scant attention (Smale et al. 2004), so that the first step in addressing the problem is to develop and test the conceptual and methodological tools needed to carry out these evaluations.

As on-farm conservation projects are implemented and new projects are designed, donors, policy-makers and practitioners need to have the conceptual and methodological tools to assess the success of their projects and the lessons learned, and hence their investments. This in turn should enable them to design and implement better projects that maintain crop diversity more effectively and deliver higher levels of well-being to the farmers who maintain it. The project entitled *Assessing the Success of On-Farm Conservation Projects in Delivering Conservation and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools* was carried out between March 2010 and May 2012 to develop and test the necessary conceptual and methodological tools to deliver these results.

A. Project Research Design

The **overall goal** of the project was to strengthen the contribution of on-farm conservation projects to improvements in livelihoods and food security in poor and/or marginal areas. The **specific objective** was to improve the ability of donors, policy-makers and practitioners to assess the extent to which on-farm conservation projects have contributed to increased diversity on-farm and to the creation of livelihood benefits that in turn encourage farmers to conserve diversity, creating a feedback loop that ensures both diversity and its continuing benefit to present and future generations.

The objective was achieved by applying appropriate methodologies and approaches to a project design that deliver the following **four outputs**:

- A **framework and a methodology** to analyze and measure the extent to which interventions by projects aimed at supporting on-farm conservation deliver conservation and relevant livelihood outcomes
- **Assessment of the impact** of a sample of specific projects on on-farm conservation funded by the McKnight Foundation and other donors
- A set of conceptual and methodological **t**ools in the form of **guidelines and best practices** to design on-farm conservation projects to deliver impact and measure it
- **A set of training tools** to enhance the capacity of donors and policy-makers to assess *ex ante* and *ex post* on-farm conservation projects and of implementers to design projects that both deliver and measure impact.[1]

[1] The set of training tools will be extracted from this final report and appendices and produced in a user-friendly format for dissemination to potential users.

The **fundamental hypothesis** tested in this project was that on-farm conservation interventions can yield conservation and livelihood oriented outcomes that generate benefits for those farmers and their families involved in them. In order to test this hypotheses we addressed four **methodological issues** by: (1) defining the conservation and livelihood outcomes that project interventions are (*ex ante*) or were (*ex post*) expected to achieve; (2) developing measurable indicators of those outcomes; (3) establishing a proper comparison for project interventions against what would have happened without them (counterfactual); (4) identifying and correcting for confounding factors in the final assessment of the impact (i.e. factors that are independent of the project interventions but that can affect the outcomes, either masking or exaggerating their impacts). Hence the project has addressed the following **major questions**:

a) Is there a definition of the conservation and livelihood outcomes that project interventions are (*ex ante*) or were (*ex post*) expected to achieve?

b) Do measurable indicators of those outcomes exist?

c) Can we compare project interventions against what would have happened without them (counterfactual)?

d) Can we identify and correct for confounding factors in the final assessment of the impact (i.e. factors that are independent of the project interventions but that can affect the outcomes, either masking or exaggerating their impacts)?

Definition: Project Intervention:

Activities carried out by a project that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity.

The project has therefore developed a framework based on a critical review of the theoretical and empirical literature that addressed the four challenges identified above. This framework is more fully explained in the section below on theory of change. The trajectory from implementation of project activities to project impact are summarized in an impact pathway diagram in Figure 1 (Annex A).

Theory of change for the project

The expected outcome, through the identification of successful approaches and methodologies and the production and dissemination of guidelines, will be an increase in the ability of donors, policy-makers and practitioners to make decisions regarding the selection and evaluation of interventions and to translate these decisions through project outcomes into impact. The theory of change to which we refer is represented in Figure 2 (Annex A) and is made up of a double cycle of change. Donors and policy makers have funded and provided assistance to projects developed by practitioners that affected farmer's management and use of biodiversity, which in turn contributed to changes in diversity and livelihoods. Through this research we aim to study this process in order to derive relevant outputs that would change donors, policy-makers and ultimately practitioners' management awareness of on-farm conservation projects. The main output of this research is in fact

the identification of a set of best practices and guidelines, which will constitute valuable public goods and serve as a series of learning tools for practitioners and donors. The delivery of these outputs will then affect the way donors, policy makers and practitioners fund, design and develop on-farm conservation projects producing changes in the ability of farmers of achieving diversity and livelihood outputs.

B. Conceptual Framework

The theory of change is the basis upon which the project design and the impact pathway were developed. This is conceptualized in the model described below, which outlines the way in which outputs from on-farm conservation projects are translated into impact that effects the desired change.

A simple model of impact for an on-farm conservation project

Any project aimed at the on-farm conservation of crop diversity intends to influence outcomes in three areas: (1) the relevant crop diversity and associated practices maintained in an agricultural system; (2) the private benefits that farmers and their households derive from that agricultural system (referred as livelihood benefits, e.g. food security, nutrition, income, safety net, cultural identity), and (3) the public benefits that society derives from the crop diversity maintained in an agricultural system (referred as societal benefits, e.g. option values derived from crop evolution). These three outcomes are the result of complex interactions among different biological, biophysical and socioeconomic processes and are in themselves multi-dimensional and can occur at different scales. They are interrelated and dynamic, but to simplify their relationships, they can be represented in a relatively simple framework. For any farming household or community (a group of farming households linked by a local seed system), in theory, we could map its position with respect to the crop diversity it maintains and the private benefits it derives (point A) (Figure 3.1 in Annex A).

Definitions

Crop diversity: *The number of distinct populations of a particular crop species recognized and managed by a farming household or community.*

Outcome: *The result of a complex process. In the context of a project, refers to the result of the use or adoption of project outputs.*

Livelihood benefits: ***The private benefits*** *that farmers and their households derive directly from crop diversity maintain in their agricultural system (e.g. food security, nutrition, income, safety net, cultural identity)*

Societal benefits: ***The public benefits*** *that society derives from the biodiversity maintained in an agricultural system (e.g. ecosystem services, adaptive evolutionary processes)*

Evolutionary services *refer to all of the uses or services to humans produced from evolutionary processes that contribute to maintain options open to benefit from biodiversity*

Since agricultural systems are not static, the position of a community in this graph changes, moving to the lower right of the graph under economic development, assuming that livelihood benefits increase with increased specialization, but with a concomitant decrease in the level of crop diversity (point B). This could be seen as the conventional view of the relationship between crop diversity and agricultural change that assumes a trade-off between these two outcomes. It should be stressed that we are not assuming a causal relationship between these two outcomes, but just representing a trend that is commonly assumed. The actual causal relationship is complex and contextual.

One can imagine a hypothetical relationship between a metric that summarizes the level of crop diversity present in a landscape and the public benefits that this diversity generates, such as the option values associated with maintaining crop evolutionary processes (evolutionary services).

(Figure 3.2 in Annex A). Obviously, this relationship is quite complex and we know very little about the actual functional form that may relate these two outcomes, but for argument's sake we assume a sigmoid shape. There may be no benefits relevant for humans below a minimum threshold of crop diversity. Once this threshold is passed then additional diversity contributes positively to the evolutionary services generated by crop diversity, but probably at a decreasing rate up to a point where no additional benefits are produced and a plateau is reached.

Assuming compatible scales in the crop diversity metric in both figures, Figure 3.1 can be flipped by 90 degrees to the left in order to align the crop diversity axis with Figure 3.2, resulting in the relationships depicted in Figure 3.3 (Annex A) that connects the three outcomes relevant for on-farm conservation (note that private benefits increase from left to right, while public benefits increase from right to left). Then one can map the position of a community with respect to the private livelihood benefits that it derives from crop diversity and the public benefits it contributes to society by maintaining this diversity. The figure also maps the trade-off described above, where economic development leads to a decrease in crop diversity, which in turn leads to a major loss of the public benefits associated with the evolutionary services generated by crop diversity. If maintaining or increasing the public benefits derived from crop diversity is socially desirable, then interventions that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way farmers and communities access, manage, use, perceive, consume and/or market crop diversity could be implemented in order to decrease the slope of the trajectory of change (and hence introduce a shift upwards), thereby reducing the loss of public benefits associated with that biodiversity.

A series of scenarios are presented (Figure 3.4, Annex A) to illustrate how these interventions could change these relationships (the letters with the superscript refer to the different scenarios and are used to identify changes in the points from the right part of the figure into the left one). Scenario 1 is the same as depicted in Figure 3.3, i.e. the process of change with a negative trend without any interventions, i.e. the counterfactual to the interventions. Scenario 2 presents the situation where, while there is still a negative trend in the relationship between the crop diversity maintained by a household or a community, interventions are implemented to shift the trend upward, leading to a much reduced loss of crop diversity and hence of the associated public benefits compared to Scenario 1, particularly since the relationship between crop diversity and public benefits is non linear. This indicates that if there is a plateau in the functional link between crop diversity and the evolutionary services it provides, it is possible to reduce crop diversity at little or no cost in public benefits, and hence not all loss of crop diversity is necessarily socially unacceptable.

Scenario 3 presents a situation that many may consider ideal, where crop biodiversity is maintained at is original level, delivering all associated public benefits of crop diversity together with a major improvement in the private benefits captured by a community. Finally, Scenario 4 presents a worst-case, showing a trend in which both crop diversity and associated public benefits and private benefits of a community are reduced. This case may correspond to changes in the economic and social environment that lead to the abandonment of crop diversity but without any associated private benefits to the communities. For example, the introduction of a new crop leading to the total abandonment of the traditional crop in the hope of increasing income, followed by a collapse in the price or market of the former due to competition, changes in consumer tastes, or failure to produce due to the appearance of a non-controllable pest or disease.

In the context of this simple schema, an on-farm conservation project can be seen as a set of interrelated interventions that provide innovations to farmers aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity. In a successful project, these innovations are adopted by farmers and in turn translate into private (livelihood) benefits for them and their households in terms of enhanced income, food consumption and security, productivity, stability, and/or reduced vulnerability. The new ways crop diversity is used and managed leads to its

maintenance in the agricultural system, where it continues to yield public benefits (e.g. evolutionary services) (Figure 3.5, Annex A). If the private net benefits (private benefits derived from these innovations minus the costs of implementing them) are judged by farmers as desirable enough, this should lead them to continue to apply them beyond the lifetime of the project, ensuring the sustainability of the process (Figure 3.6, Annex A). Thus this simple framework provides a conceptual basis for analyzing the generic structure of an on-farm conservation project and assessing its success and sustainability.

From this model it is clear that assessing the success of on-farm conservation project requires answering four questions:

1. Do farmers apply the innovations provided by project interventions?
2. If so, does the application of these innovations lead to farmers maintaining levels of crop diversity higher than would have been possible without them?
3. Does this higher level of crop diversity lead to increased well-being among the households of farmers who applied the innovations?
4. Does the level of crop diversity associated with the application of innovations deliver additional evolutionary services that would not have occurred otherwise?

Answering positively to these questions will indicate that a project was successful. This implies that farmers who apply the innovations provided by project interventions: (a) maintain higher levels of crop diversity compared to those who do not apply them, and (b) that those farmers who maintain higher levels of crop diversity obtain additional benefits from this diversity compared to those with lower diversity. These implications can be tested empirically. This requires, on the one hand, clear and measurable indicators of adoption, significant levels of diversity and relevant well-being, and, on the other, a proper set of comparisons. Answering the first three questions is quite straight-forward, although it requires the appropriate methods and design. However, as indicated earlier, the answer to question 4 is still quite difficult since the functional relationship between levels of crop diversity and the generation of evolutionary services is little understood, although a simple principle may be that under uncertainty "more is better than less." Then by placing on-farm conservation projects in known areas with high levels of crop diversity, we insure that public benefits are delivered.

C. The Study Area and State of Diversity

The High Andes region of Latin America was selected as the study area based primarily on the basis of three factors: 1) it is a center of the origin and diversity of many important crops; 2) it is a center of cultural diversity and poverty; and 3) the custodians of the rich agro-biodiversity are poor, smallholder farmers.

The Area: The Andean region offers abundant opportunities for the promotion of *in situ* conservation of crop genetic resources. It is considered the most diverse region in the world, containing a sixth of all plant life in less than one percent of the world's land area (Conservation International, 2007). The co-existence of fertile inter-Andean valleys with mild climates with fields situated at high altitudes exposed to cold weather has made agricultural biodiversity in the Andes extremely diverse.

The Diversity: Due to the diversity of ecosystems found in the Andes, many crops, including potatoes and tomatoes, have originated in this region and Andean people have domesticated tens of different species, including roots, grains, legumes and fruits for thousands of years, resulting in a rich diversity of native cultivars adapted to unique ecological conditions. Native Andean crops such as roots and tubers, in fact, give good yields in poor soils under adverse climatic conditions as well as being tolerant to various pests and diseases.

The potential and observed richness of Andean crops are mapped in Figures 4 and 5 in Annex A.

The Threat: However, this rich diversity is being lost due to changes in consumption patterns, monoculture technologies, unfavorable marketing opportunities and undiversified diets (UNORCAC 2008). Markets have become more homogeneous worldwide, reducing demand to a narrow range of varieties. In addition, genetic erosion or the loss of varieties of seed, native cultivars and their wild relatives due to factors such as deforestation, desertification, soil erosion, and climate change. The lack of clear policies to benefit farmers, technological dependence and the implementation of an economic model based on the market, has deepened the food problem in the region, as have other anthropogenic factors such as mining, timber extraction, oil exploration, and narcotics plantations. This situation is aggravating the precarious condition of indigenous people and communities that live in remote Andean areas and make the widest use of this diversity.

Andean crop varieties have high nutritional values, but their consumption has been marginalized and replaced by commercial crops and their nutritional properties and wide range of uses are not widely known. Today they represent complementary crops for poor families. Their cultivation is also limited by the lack of continued support for research and promotion. As a result, their consumption and supply is often limited to producers in remote areas, processing methods are unsophisticated; and prices are often too low and costs too high to make them widely marketable.

Andean culture and poverty: Bolivia, Ecuador and Peru suffer from extremely high degrees of inequality, with poor people concentrated in isolated rural areas of the Andes, depending for their survival on insufficient land holdings and fragile ecosystems (IFAD, 2010). The majority of poor people in these countries are in fact peasants, mostly of indigenous origin. These indigenous populations are especially important for the conservation of biological diversity as it is highly correlated to their cultural diversity (Brush, 2000). In the Andes, Quechua and Aymara speakers are the primary nurturers of agro-biodiversity. *In situ* conservation is practiced by a great number of Andean farmers, especially small farmers in remote areas, and is considered part of the cultural heritage of the Andean region. For centuries poor farmers in the region have engaged in the breeding of plants in their own environment, allowing continuing evolution and the use of crops in multiple ways that allow a healthy life and diet for current and future generations (INIEA, 2005).

Selection of project locations: Although Bolivia, Ecuador and Peru are characterized by the presence of thousands of agricultural institutions working in different areas from livestock and plants conservation to technology promotion, the interventions specifically aimed at *in situ*-on-farm conservation are few, partly because of the relative newness of such practices and partly due to scarce investment. It is important, then, to study the efforts that have been undertaken by local and national organizations, often in concert with international research institutions and donors, to determine what interventions work best in protecting this Andean heritage and improving livelihoods of the Andean poor. The process of selecting on-farm conservation projects for use as case studies started with a sample of 36 projects that emerged from an extensive review of relevant literature. These projects were located in: Bolivia, in the area of La Paz, Potosí and Cochabamba; Peru, in the area of Cusco and Puno; and in Ecuador in the area of Chimborazo. A further search for information on these projects resulted in the elimination of several for which important data were unavailable. The remaining 26 projects were researched in greater detail (See Table 1) and formed the population from which the final six case studies were selected.

Table 1: List of projects directly aimed at on-farm conservation

	Project Title	Target	Implementing Organization	Main Donor	Location
1	**Proyecto Integral Las Huaconas (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))**	Andean tubers: oca, ulluco, mashwa, arracacha, mauka, yam bean	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Departamento Nacional de Recursos Fitogenéticos y Biotecnología (DENAREF) CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	Las Huaconas, Chimborazo Ecuador
2	**Proyecto Integral Candelaria (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))**	Andean tubers: Papa (Solanum andigena, S. stenotomum, S. ajanhuiri, S. phureja), oca, ulluco, mashwa	Promoción e Investigación de Productos Andinos (PROINPA) Asociación de Productores de Tubérculos Andinos de Candelaria (APROTAC) Programa de Alimentos y Productos Naturales (PAPN-UMSS) San Simon University Proyecto de Mercadeo y Comercialización de los Tubérculos Andinos (PROMETAS-UMSS) CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	Alto San Isidro, Primera Candelaria, Rodeo Alto and Tabla Mayu communities, Candelaria, Cochabamba Department, Bolivia
3	**Proyecto Integral Altiplano (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))**	Andean tubers: oca, ulluco, mashwa	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Promoción e Investigación de Productos Andinos (PROINPA) CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	Yunguyo, Puno Region, Perú Copacabana-Escoma, Región de los kallawayas, La Paz Department, Bolivia
4	**Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))**	Andean roots: Arracacha	CONDESAN IESE – UMSS (Instituto de Estudios Sociales y Económicos de la Universidad Mayor de San Simón)-Bolivia INIAP (Intituto Nacional de Investigación Agropecuaria) ESCAES (Escuela Campesina de Educación y Salud) UNC (Universidad Nacional de Cajamarca), Peru CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	San Juan de la Miel, La Paz Department, Bolivia San José de Minas, Quito, Pichincha Province, Ecuador Sucse, Cajamarca Region, Perú
5	**Native Potato: improved production of native potatoes in the Andean highlands of Peru**	Andean tubers:	Intermediate Technology Development Group (ITDG), Peru Instituto Nacional de Innovacion Agraria (INIA), Peru Central de Autodefensa de Pataccalasaya (CAP), Peru	McKnight Foundation	Quechua and Aymara communities, Cusco Region, Peru
6	**Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands**	Andean tubers: oca, ulluco, potato	CIP (Centro Internacional de la Papa) University of Cuzco/CRIBA	McKnight Foundation	Cusco, Cusco Region, Peru
7	**Uso, manejo y conservación *in situ* de tres variedades locales**	Andean tubers: papa	CEDIR	United Nations Development Programme	Provincia Azuay, Provinica Cañar, Ecuador

	Project Title	Target	Implementing Organization	Main Donor	Location
	de papa en el Austro Ecuatoriano			(UNDP)	
8	**Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica, Peru**	Andean Tubers	Grupo Yanapai, Peru Federación de Mujeres Campesinas de Yauli (FEMUCAY), Peru Federación de Comunidades Chopccas-Yauli, Huancavelica, Peru National Agricultural Research Institute (INIAP) CIP (Centro Internacional de la Papa)	McKnight Foundation	Yauli and Pacara districts, Huancavelica, Peru
9	**Potato moth: biopesticide development and diffusion of potato moths. Integrated management to strengthen food security in the Ecuadorian Andes**	Andean Tubers	Pontificia Universidad Católica del Ecuador (PUCE), Ecuador Institut de recherche por le développement (IRD), Ecuador Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP)	McKnight Foundation	Guntuz Community, Riobamba Canton, Chimborazo Province, Ecuador
10	**Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi, provincia Chapare – Cochabamba**	Andean roots: leafcup, arracacha, ajipa and yam bean	Promoción e Investigación de Productos Andinos (PROINPA) Asociación de Productores y Procesadores Ecológicos de Agrodiversidad (APyPA)	Fundacion PUMA via Iniciativa para la America (EIA)	Colomi, Chapare Province, Cochabamba Region, Bolivia
11	**Bioversity NUS-Bolivia/Peru**	Andean grains: Quinoa Cañihua Amaranth	Bioversity International Promoción e Investigación de Productos Andinos (PROINPA) CIRNMA (Perú - Ministry of Agriculture)	IFAD	Santiago de Okola Coromata Media Cuevas Canadas Mojotorillo Bolivia Cieneguillas Corisuyo Auquiorko Ocoruru, Peru
12	**Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA**	Andean grains: Cañahua Quinoa	PROINPA Foundation Subsistema de Granos Altoandinos del SINARGEAA Universidad Mayor de San Andrés – UMSA Universidad Técnica de Oruro – UTO Centro de Investigación y Producción Comunal de Irpani - CIPROCOM.	Bolivian Government - Sistema Boliviano de Tecnología Agropecuaria (SIBTA)	La Paz: Coromata Media Chauhira Chico Jalsuri, Colina Patarani, San Pedro y San Pablo, Rosapata Erbenkalla, Kalla Arriba, Tacaca Corpa, Tiahuanacu, Titijoni, Cachilaya, Cutusuma, Cutusuma Alta, Igachi, Kealluma, Río Grande, Chojñacollo, Avicaya, Cariquina Grande, Jutilaya Chiaruyo, Pomposillo Pusucani, Asunción de Huancarama Iñacamaya, San José de Llanga, Vitu Calacachi, Salviani, Ayamaya Oruro: Tola Phujru, Tika Noka, Quillacas, Sullka Tunka, Chuquichuru, Condoriri, Irpani Potosí: Chacala, Sajsi Cochabamba: Llaytani. Bolivia

	Project Title	Target	Implementing Organization	Main Donor	Location
13	**Desarrollo Sostenible de Quinua Orgánica en el Perú**	Andean grains: Quinoa	Instituto Nacional de Investigación y Extensión Agraria (INIEA) Universidad Nacional del Altiplano (UNAP) Asociación Agroindustrial de Granos Andinos (ASAIGA)	Scanagri/NIRAS	Cabana, Puno, Lima, and Cusco, Peru
14	**Sustainable production of quinoa: a neglected food crop in the Andean region**	Andean grains: Quinoa	Promoción e Investigación de Productos Andinos (PROINPA)	McKnight Foundation	Salar de Uyuni, Potosi Department, Bolivia
15	**Lupin/ Quinoa: Sustainable production systems to guarantee food security in impoverished communities in the province of Cotopaxi, Ecuador**	Ansean grains: Lupin Quinoa	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Social Development Committee "Path to Progress" (CODESOCP)	McKnight Foundation	Saquisili, Cotopaxi Province, Ecuador
16	**Conservación complementaria *ex situ* - *in situ* de especies silvestres de quinoa y cañihua en Bolivia**	Ansean grains: Quinoa Cañihua	Promoción e Investigación de Productos Andinos (PROINPA) Fundación Amigos de la Naturaleza	Global Environmental Facility (GEF) Bioversity International (IPGRI)	Cariquina Grande (Provincia Camacho), Cachilaya (Provincia Los Andes), Titijoni (Provincia Ingavi) y Coromata Media (Provincia Omasuyos). La Paz Department, Bolivia
17	**Programa de apoyo a la cadena quinoa altiplano sur**	Ansean grains: Quinoa	Fundación Autapo	Dutch Embassy	Altiplano Sur, Potosi, Bolivia
18	**Green manure and legumes: integrating agronomic and health research for improving the production of food and diets in marginal areas of Northern Potosi**	Andean Legumes	World Neighbours	McKnight Foundation	Municipalities of Sacaca, San Pedro de Buenavista and Acasio, Potosi Department, Bolivia
19	**Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)**	Andean Legumes Grass species	Manejo Comunitario de Recursos Naturales (MACRENA) World Neighbours	McKnight Foundation	Ibarra, Otavalo and Cotacachi, Carchi and Imbabura provinces, Ecuador
20	**In-Situ Conservation of Native Cultivars and Their Wild Relatives**	FRUITS: camu-camu, granadilla GRAINS: cañihua, maize, Quinoa LEGUMES: lima beans ROOTS: arracacha, maca, sweet potato (yuca), mauka TUBERS: Papa	Instituto Nacional de Investigación y Tecnología Agraria (INIA)	UNDP Global Environmental Facility (GEF) - Small Grant Programme	SIERRA NORTE (Cajamarca), SELVA ALTA (Loreto), SELVA BAJA (San Martín), SIERRA CENTRAL (Huancavelica y Junín), COSTA CENTRAL (Ica y Lima) y SIERRA CENTRO SUR (Ayacucho), Peru
21	**Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el Noroccidente de Pichincha**	Forest Ecosystem	Fundación Rainforest Rescue – FURARE UNDP	Global Environmental Facility (GEF)	San Miguel de los Bancos, Pichincha, Ecuador

	Project Title	Target	Implementing Organization	Main Donor	Location
22	**Conservation of Biodiversity in Pastaza**	Palm trees, fruit trees, timber and medicinal plants	Instituto Quichua de Biotecnología Sacha Supai Global Environmental Facility (GEF) Inter-institutional Network of Specialists in Environmental Management	Global Environmental Facility (GEF) Co-financing	Quichua communities of Yana Yacu, Nina Amarun and Lorocachi, Pastaza Province, Ecuador
23	**Conservacion complementaria y uso sostenible de cultivos subutilizados en Ecuador, rescate, promocion y uso de recursos fitogeneticos interandinos de Ecuador**	Neglected and underutilized species (NUS): tree tomato, cucurbitaceas (sambo and banana squash (zapallo)), banana passionfruit, granadilla and chili peppers	Instituto Nacional de Investigaciones Agropecuarias (INIAP) United States Department of Agriculture (USDA) Unión de Organizaciones de Campesinos de Cotacachi (UNORCAC) Unión para la Cooperación y Desarrollo de los Pueblos (UCODEP) Bioversity International (IPGRI)	FAO	Cotacachi, Imbabura Province, Ecuador
24	**Conservación y manejo de la agrobiodiversidad en la cordillera de El Cóndor**	Neglected and underutilized species (NUS)	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Departamento Nacional de Recursos Fitogenéticos y Biotecnología (DENAREF)	SDC (Suisse Agency for Development and Cooperation)	Municipios de San Juan Bosco, Limón y Gualaquiza, Morona Santiago Province, Ecuador
25	**Seed systems. The biological foundation of food security in the Andes**	Andean crops	World Neghbours, Ecuador DIPEIB-Chimborazo, Ecuador DIPEIB-Cotopaxi, Ecuador FUNPRODIB, Ecuador Wageningen University and Research Centre, Netherlands	McKnight Foundation	Bolivar, Chimoborazo, and Cotopaxi Province, Ecuador
26	**Removing Obstacles to Direct Private-Sector Participation in In-situ Biodiversity Conservation**		Protection of the Environment Tarija (PROMETA) World Bank The Nature Conservancy Servicio Nacional de Areas Protegidas (SERNAP)	Global Environmental Facility (GEF)	Bolivia

II. Methodology, implementation, analysis and results

The methodological framework employed by the project to evaluate the on-farm conservation projects consisted of both qualitative and quantitative methods. The qualitative methods involved a review of relevant literature, key informant interviews and a network analysis. The quantitative analysis comprised two components. One is a descriptive part based on the surveys characterizing the households in the sample in socioeconomic terms by reporting frequencies, means and standard deviations of key relevant variables. This analysis also paid particular attention to the interventions applied by each of the projects, the rates of participation, adoption and how these were evaluated by farmers. Also through interviews with project leaders, it was established whether each intervention could be firmly attributed to the projects or only with a degree of uncertainty, either because other projects in the area promoted the same type of intervention or because the intervention consisted in disseminating local practices to a wider local audience[2].

[2] Since these are local practices it would be difficult to establish unequivocally that the project contributed to their dissemination, because they could have disseminated on their own without any project. In the case of completely new interventions establishing the attribution is easier since without the project these interventions are very unlikely to have happened.

A. Literature review (desk review)

An Internet search for as many projects as possible that dealt with on-farm conservation of the diversity of native crops and livelihood improvement in the high Andes of Bolivia, Ecuador and Peru was carried out. The following key words were used: agrobiodiversity, on-farm conservation, biodiversity and livelihood. The main objective of the review was to analyze the indicators used in these projects and understand the links between objectives, activities implemented to achieve them, and diversity and livelihood outcomes, in order to trace a preliminary best practices pathway. To do this, we carried out an inventory of the types of activities executed and identified the indicators of success used, and the associated crop diversity and livelihood outcomes sought and achieved.

The studied projects were mostly financed by foreign donors that included different types of organizations, such as the "Small Grants Programme for Biodiversity", funded by the Global Environment Facility (GEF) and administered by UNDP, which funds small projects (with a budget averagely ranging from 20,000 to 40,000 USD), often co-financing with other agencies. The SDC (Swiss Agency for Development and Cooperation) funded many large projects in the Andean region, providing consistent support around one million USD or more. IFAD (International Fund for Agricultural Development) has also financed a global scale project with a regional focus in the Andean region of Bolivia and Peru. Finally, the McKnight Foundation and other foundations financed several small-medium projects generally aimed at biodiversity conservation and improvement of food security and livelihoods. In total, the available data indicates at least an investment of 24 million USD (for several projects there was no information on funding level). However, it is not clear over what time period this funding was carried out, although it may have been over the last ten years. This amount shows an interest on the part of foreign donors and a non-trivial investment in the issues concerning the conservation and use of local crop diversity on-farm in the Andean region of Bolivia, Ecuador and Peru. The geographical distribution of the 36 projects that emerged from the desk study included the following by country:

- Bolivia (Departments): La Paz – 5 projects; Potosí – 4 projects; Cochabamba – 3 projects; Chuquisaca – 1 project; Oruro – 1 project; and 1 national project
- Ecuador (Provinces): Chimborazo – 3 projects; Pichincha – 2 projects; Cotopaxi – 2 projects; Carchi and Imbabura – 2 projects; Cañar and Azuay – 1 project; Pastaza – 1 project; Morona Santiago – 1 project;
- Peru (Regions): Cusco – 3 projects; Puno- 3 projects; Cajamarca – 1 project; Huancavelica – 1 project ; and 1 national project

Once the 36 project documents were found in the search, they were carefully reviewed with the aim of narrowing the list to a more manageable size. Thirteen projects were eliminated because of missing information or because they did not address the necessary indicators. A final total of 26 projects aimed at conserving the diversity of native crops while improving the livelihoods of farmers and their communities were selected for further, in-depth review. (The full report of this literature review is presented in Appendix F). All of the projects either had a primary focus on on-farm conservation or were characterized by important on-farm components. This framework was used to assess a set of six case studies comprised of a sample of projects according to four main criteria: (1) directly or indirectly targeting on-farm conservation; (2) funded by the McKnight Foundation or by other donors; (3) a focus on the Andean region; (4) sufficiently documented projects, encompassing different situations in terms of interventions, countries, crops, social and biophysical environments.

The review of project documentation focused on identifying for each project: (1) specific location; (2) target crops; (3) the main donor and level of funding; (4) the executing organization; (5) the activities carried out; (6) the specific interventions implemented; (7) the outputs generated; (8) the crop diversity and livelihood outcomes that the project aimed to influence; and (9) the associated indicators. The 26 projects had a focus on the following target crops: Andean roots and tubers (10 projects), Andean grains (7 projects), and legumes (2 projects); local neglected and underutilized species (2 projects); native cultivars and their wild relatives (1 project); forest management and forest products (2 projects); seed systems of Andean crops (1 project). One project aimed at removing obstacles to direct private sector participation in *in situ* conservation.

The projects have very similar types of activities even though they were implemented by different organizations and funded by diverse donors. These activities usually included a characterization and diagnosis phase and an intervention phase. The ***characterization and diagnosis phase*** covers the following activities:

(1) The identification of areas with high crop diversity, usually referred to as micro-centers of diversity, and within these areas, a characterization of the relevant crop diversity present on-farm in terms of the number species and varieties cultivated, and sometimes the associated seed system (the different ways farmers source seed and planting material);

(2) Participatory diagnoses of the constraints faced by households producing the relevant species, as well as of the socioeconomic situation of the communities and households in the study areas and in some cases the diagnosis included surveys as well;

(3) Characterization of the uses and consumption of target species, as well as studies on their nutritional values;

(4) Characterization of markets and value chains associated with the relevant species, including their constraints in these contexts.

The ***intervention phase*** included many activities associated with different types of interventions aimed at addressing the constraints identified in the previous phase in order to increase the benefits that farmers and communities could derive from the production, consumption and marketing of the relevant crop diversity. These activities included:

1) Improving the seed supply of relevant species, particularly through the implementation of seed fairs to sensitize farmers to the crop diversity present and foster exchange and access to additional varieties; cleaning planting material mostly from viruses; improving the quality of seed; production and distribution of better quality seed and clean planting material; providing seed of lost native varieties either from other areas or from gene banks;

2) Implementation of seed fairs to sensitize farmers to the crop diversity present and foster exchange and access to additional varieties improve processing, either at the household and community levels or at the agro-industrial level, including post-harvest management and storage, which in turn should improve either the direct consumption or the marketing of the species;

3) Improvement in value chains by connecting small producers to markets, associated with better processing, new uses, as well as promotion of the species in markets to increase farmers' income;

4) Improved information about the nutritional value of the species, promotion of their consumption as a way of improving diets and nutrition, which also included activities to educate farmers and consumers about the potential nutritional benefits of consuming the species;

5) Yield improvement through better agronomic practices, identifying appropriate varieties through participatory varietal selection and providing access to them through seed distribution schemes to improve food security or income from agriculture;
6) Implementation of integrated pest management, including characterization of the pests and diseases and management interventions to control them to reduce losses and improve food security;
7) Use of leguminous species to improve soil fertility and health and enhance crop productivity;
8) Capacity building through training and extension for farmers;
9) Organizing farmers in groups to experiment and test technologies (CIALs) or to market their products and hence foster new income opportunities;
10) Establishment of home gardens to foster consumption of nutritious species;
11) Establishment of agro-tourism to offer new incomes sources to farmers.

Associated with these activities and interventions there were many indicators to measure and verify that project outputs were produced, leading to outcomes that work together to contribute to generating changes in either agricultural biodiversity or in livelihoods. The full report on the literature review (Appendix F) presents a compilation of all the agricultural biodiversity and well-being indicators resulting from the examination of the projects. It was difficult to identify from project documentation the specific changes in agricultural biodiversity and livelihoods generated by the projects (outcomes) and whether the interventions could be actually linked to these changes in a systematic and transparent manner. From the review however, there are a set of lessons that can be derived in terms of common problems faced by projects as well as good practices employed by them.

Findings of Literature Review

Common problems faced by projects include the difficulty in attracting investment in these types of projects given their low income potential. Even though there may be demand for native species (sometimes generated by the projects' own 'promotional activities), many supply-side constraints limit their potential to improve their status in markets and provide income to farmers, for example due to a missing or under-developed agro-industrial capacity needed to develop new products. Management practices along the value chain tend to be outdated and unable to insure the quality needed for better marketing. Lack of organization among producers, which creates high transaction costs and increases prices, together with a lack of knowledge about marketing, limit the competitiveness of products derived from native species in value chains. Lack of infrastructure from roads, processing facilities and transportation to storage facilities, together with the remoteness in which many of the target farmers are located, further reduce commercial competitiveness. Low demand can be a problem as well and promotional strategies can be important for overcoming it; however, the design of these strategies should take into account an understanding of the socioeconomic segmentation of demand[3] in order to tackle the scarce profitability of the commercialization of Andean crops and related products. Low demand may continue to be a constraint if consumption patterns do not change towards increased acceptance of products derived from native species in the region, which in many cases is hampered by cultural notions such as

[3] Quoting the McKnight project 'Strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands': 'in urban marginal neighborhoods of Cusco the most important characteristic of ulluco is its nutritive value and its low price; by contrast, in the richest neighborhoods the most important quality of the ulluco is that is perceived as a healthy product'.

identification of these species as “food of the poor” or having low social status. Cultural notions and taboos can also limit the adoption of improved management practices.[4]

Overall, projects do not apply clear measurable indicators of outputs and outcomes. Often indicators have to be inferred by the researcher as they are not clearly defined or explained and the links between outputs and outcomes are sometimes weak or questionable. It was difficult to understand what a relevant indicator is because some project reports did not provide this information and we had to infer it according to the logic of interventions. The definitions of “outcome,” and “output” as well as “indicator” itself is confusing and never made explicit, despite the fact that their definition has been widely disseminated by different international actors. The terminology used in the reports is rather that of ‘result’ which we have understood as a synonym of outcome and in some cases of output. Greater clarity would be beneficial to the assessment and dissemination of project results and to improved understanding of how project implementation is linked to the logical and theoretical framework within which it operates.

From a project operational perspective, an important limitation is the late arrival of funding and bad timing between organization, planning, availability of funding and implementation of activities, limiting reliable and good results. At the field operational level an important limiting factor is the motivation of authorities and farmers to participate. Some projects lament that in participatory activities and training sessions people are often more interested in snacks than training. Moreover, local authorities do not have the leadership to motivate the population to pay attention to such events, and people sometimes plan other community activities on the day when trainings are planned. Local institutional and organizational support is limited, which also constraints the creation of networks and diffusion of project activities. The low interaction and support from the formal and institutional sector to local groups or individual farmers is a great constraint to the sustainability and effectiveness of projects.

Gender is an important aspect of the lives of rural people in the Andes. Women in particular play a key role in the use and conservation of native crops and varieties, but there are gender differences in the power to make decisions and, unfortunately, in the projects gender issues and women’s empowerment generally did not receive sufficient attention. Only eight projects had a specific component to address gender empowerment, an area that merits further action in the future. Another aspect not directly tackled in the assessment of projects’ results is their impacts on traditional inequality between classes or ethnicities, particularly relevant issues, especially in those projects aimed at the empowerment of indigenous communities through natural resource conservation.

In spite of these common problems, several ***good practices*** also emerged from the analysis of these projects. A common feature of most projects was their use of participatory approaches that engaged project implementers with farmers and communities in a dialogue that gave voice to their objectives, concerns and priorities in project implementation. This type of approach also provides strong recognition to local culture and knowledge, which is central among the millenary cultures of the Andes. Participatory approaches were particularly useful in characterizing the diversity of native species and varieties, their uses, selection criteria that determine their acceptability and their associated seed systems, as well as in characterizing the socioeconomic conditions of households. The use of these approaches allows the identification of knowledge gaps among farmers and technicians and suggests the appropriate learning tools to develop.

[4] For instance, the ‘Lupin/Quinoa’ McKnight project had to face a myth that if potatoes are covered with too much earth they don’t thicken, although that is not true, and moreover earth keeps moth and maggots away

The projects focused on generating interventions that improve crop management, processing, marketing and consumption adapted to the socio-economic conditions of farmers. The interventions included the formation of local agricultural committees (CIALs) and farmer field schools to foster learning-by-doing, as well as strengthening local organizations and rural networks by building capacity among them. Demonstration and trial plots were important tools for exposing farmers to new technologies, while seed exchange fairs provided farmers with opportunities to know and promote the planting and consumption of native cultivars while improving the exchange of information between communities and among farmers. To tackle the limited market for native crops, some projects aimed at creating and promoting adjacent sustainable productive activities such as ecotourism initiatives, use of ornamental and medicinal plants, and artisanal work. However, sustainability and viability plans for these activities are seldom available. Communities seem interested in producing and preparing alternative recipes with nutritious foods derived from their native crops. Culinary contexts, exhibitions and fairs appear to be a good way of engaging local populations. Promotion also seems successful, especially through the use of radio campaigns. At the individual level, projects seem to have achieved some impacts in terms of self-esteem among participants, particularly women. However, these impacts, though quite important, are difficult to measure and are usually left to superficial analyses that merit further attention.

B. Case studies selection and key informant interviews

Case study selection: A sub-set of six projects was selected from the 26 projects reviewed for further study and an in-depth quantitative analysis. These studies were selected during a workshop held in Cali, Colombia with the expert knowledge of the participants and the information obtained through the key informant interviews. The aim was to have a mix of projects with the following criteria: (a) funded by different donors (including the McKnight Foundation, but not limited to it); (b) two in each country; (c) implemented by different types of organizations and (d) encompassing different types of interventions, crops, social and biophysical environments (Table 2).

Telephone interviews with key informants were carried out to validate and add to the information gathered from project reports. Information on the design of interventions and lessons learned from the implementation of projects was gathered during the interviews by asking opinions on gaps and strengths and other factors relevant to understanding which activities achieved the most significant outcomes. Key informants included project leaders and others directly involved in the projects judged to have specialized and in-depth knowledge about the project. At the initial workshop in Cali it had been decided to examine three case studies in depth, one from each country. Following conversations with key informants in Peru and Bolivia, three additional projects beyond the three discussed in Cali were identified and deemed extremely interesting. Project leaders were contacted and were keen to discuss with us their projects; therefore the projects were included in the analysis. The final list of six case study projects studied is detailed in Table 2 :

Country	Project Title	Main Donor	Implementing Institutions	General Objective	Target crops
Peru	Biodiversity of Andean tubers: strengthening the on-farm conservation and food security of Andean tubers in the fragile ecosystems of the southern Peruvian highlands	McKnight Foundation	University of Cusco/ CRIBA	To strengthen the dynamics of in-situ conservation of Andean tubers (native potatoes, oca, and mashua olluco) and improve food security and income of the high Andean communities of the Cusco Region	Andean tubers: oca ulluco potato
Ecuador	Complementary conservation and sustainable use of underutilized crops in Ecuador (Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador)	USDA	Instituto Nacional de Investigaciones Agropecuarias (INIAP) and Union de Organizaciones Campesinas de Cotacachi (UNORCAC)	To promote rural development through the complementary conservation and the sustainable use of plant genetic resources of underutilized native crops of the inter-Andean valleys of Ecuador, through the collaboration between rural communities of Cotacachi, researchers and national and international agencies	Neglected and underutilized species: tomato cucurbitaceas (sambo and banana squash (zapallo)), banana, passionfruit, granadilla, chili peppers
Bolivia	Enhancing the Contribution of Neglected and Underutilized Crops to Food Security and to Incomes of the Rural Poor (Bioversity-NUS):	IFAD	Bioversity International	To contribute to raising the incomes and strengthening the food security of small farmers and rural communities around the world through securing and exploiting the full potential of the genetic diversity contained in neglected and underutilized species	Andean grains: quinoa cañihua amaranth
Peru					
Peru	Improved Production of Native Potatoes in High-Altitude Areas of the Peruvian Andes	McKnight Foundation	Intermediate Technology Development Group (ITDG)		Andean tubers
Ecuador	Lupin/ Quínoa : Sustainable production systems to guarantee food security in impoverished communities	McKnight Foundation	National Program for Andean Legumes and	To alleviate the levels of poverty and malnutrition in the Province of Cotopaxi through the	Andean grains: quinoa

			Institute (PRONALEG-GA of INIAP)		
Bolivia	Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA		PROINPA	To ensure the conservation of High Andean grain germplasm and increase its usability through a coordinated effort between the Active Germplasm Bank of the Subsystem, the Work Collections and other strategic alliances.	Andean grains

* A seventh project on the sustainable development of organic quinoa in Peru was eliminated from the final selection of case studies due to the inaccessibility of information on the main actors in the project.

Immediately after the phone interviews, fourteen internet Survey Monkey ***questionnaires*** were developed and sent to the key informants. The survey was submitted to each of the project leaders in addition to other people who were directly involved in the interventions. Not all of the key informants interviewed by phone answered the survey. As the survey was fundamental to the scope of the study, one of the seven projects (Proyecto Integral Candelaria) was eliminated from the analysis, although relevant information gathered in the phone interview was used in the discussion.

The questionnaire elicited information on budgets, donors, start and end dates and project objectives. A list of project activities identified from the literature review and interviews was compiled for each project, and interviewees were asked to rate those activities in a scale of usefulness from "1=not useful" to "5=very useful." They were also asked about the specific duration of activities and whether project outputs were achieved and related documents produced. After the compiled questionnaires were collected, the case studies were analyzed using project reports and other documents provided by key informants in order to understand the implementation pathway and what activities were carried out in order to achieve the claimed outcomes.

Interviews with case study leaders: Interviews and a survey questionnaire with selected case study leaders and other selected project participants yielded specific information on the activities carried out in these projects. Identified project activities were grouped into four thematic areas: (1) status and trends of the diversity of target native species; (2) utilization and consumption of these species; (3) capacity building among participating farmers and organizations; (4) dissemination and promotion to foster the improved use, conservation, and management of target species. There were 27 types of activities carried out in at least half of the projects and all of them were considered useful to medium useful (average ratings above 3).

Status and trends of the diversity of target native species: The most common activity carried out by projects were the collection and characterization through morphological, agronomic and molecular analyses of the different varieties of target native species in order to understand the crop diversity used by farmers and define appropriate interventions. Subsequently many projects carried out regeneration and multiplication of local varieties (in many cases after cleaning the planting material of viruses) as well as new, improved varieties adapted to local agro-climatic conditions. The second activity undertaken by most projects was participatory selection and evaluation of the native crop varieties to understand farmers' preferences for production and consumption, to determine which were the best-performing genotypes, to develop improved agronomic practices connected to the production of varieties selected by farmers, to produce quality seed, but also to raise awareness among farmers of the diversity they manage. This activity was often carried out with the collaboration of existing local Farmer Field Schools (ECAs) or Local Agricultural Research Committees (CIALs) or the establishment of new ones [5] Such participatory methods were also applied to the evaluation of traditional knowledge, the collection of socio-economic data and the analysis of on-farm conservation dynamics and have been repeatedly stressed as important in project reports and interviews with key informants. All of these activities were rated highly by interviewees, with average ratings above 4.

[5] A Farmer Field School is a participatory training methodology based on the concept of learning by discovery and fostering technology adoption and empowerment at the community and personal levels. Committees are instead aimed at professionals of national and international organizations, and to farmers carrying out research. Both are based on participatory processes to improve knowledge, practices, and cooperation. They often foster production and distribution of good quality seed for dissemination of specific varieties.

Utilization and consumption of these species: Survey results show that all projects included market studies of the target crops, which is understandable given that demand and supply constraints represent one of the greatest obstacles to a sustainable use and consumption of native species. Interventions aimed at improving marketability and supply chains associated with local diversity seemed to achieve the best results when appropriate studies of supply and demand are carried out. Half of the projects included interventions aimed at improving processing and post-harvesting practices (both particularly highly rated) and the development of new products in order to market higher quality products, improve profit margins and increase quantities of products to sell. Activities associated with the study of nutritional values of target species and their use and consumption, although not as common as the market studies, had a high average rating, indicating the importance given to these aspects by project practitioners. These studies were also considered useful for improving and re-evaluating the knowledge of spiritual and cultural values attached to consumption and use of native crops.

Capacity building among participating farmers and organizations: Capacity-building activities were common among all projects and in general highly rated (always above 4). In particular, farmer training activities were carried out by all projects and received a very high rating. Project training activities are based on the assumption that trained farmers are more willing to recover and revalue the traditional knowledge linked to native cultivars, are able to improve cultivation and production practices and therefore increase the value of their native species and associated products. The importance that projects attached to participatory approaches and strengthening of social capital in rural communities is confirmed by the high rating of training activities for local organizations such as Farmer Field Schools (ECAs) and Local Agricultural Research Committees (CIALs), which were undertaken by many projects. Training associated with consumption and use of target species, such as in recipe preparation, which is often directed at women and aim at tackling family and child nutrition and fostering women's empowerment were highly rated and attest to the importance of food consumption and nutrition in project interventions. The ratings given to training in production and processing activities are consistent with the importance given the development on new products and processing practices.

Dissemination and promotion to foster the improved use, conservation, and management of target species. The most common and highly rated promotional activities were the organization of fairs, festivals and contests along with promotional campaigns through media and local shops. Project reports and key informants highlighted the usefulness of fairs and festivals in gathering people from within and outside the communities to celebrate the diversity of target native species. Also culinary contests were widely applied to foster the use of native species and cultivars by different people, especially women. Radio programs and press reports on the experience and results of projects were extensively used to reach a broad set of audiences. Dissemination activities such as exchange visits, seminars and conferences were also common and highly rated.

Findings from Interviews

At the qualitative level, there were a certain number of issues commonly raised by interviewees. From the point of view of practitioners, participatory approaches and the active engagement of farmers, producers, technicians, and local organizations played an important role in project implementation because they help to achieve better understanding of what communities demand, improving the implementation of interventions and the dissemination of results in a way that maximizes benefits to the communities. Participatory approaches allowed farmers to become acquainted with project objectives and logical frameworks, to strengthen their cooperation with practitioners, to share opinions on priorities, limits and opportunities, and finally to 'own' the project.

Another relevant finding stressed by key informants was the need to understand that farmers have been guardians and conservationists of the diversity of native crops (local agricultural biodiversity) for centuries and that the success of interventions is based on their active involvement and ownership of project objectives and results.

It also emerged that projects that strengthen the cultural connection with native crops were the ones that reach the best outcomes in terms of acceptability and adoption. By studying markets, developing recipes, improving culinary and production practices, and revitalizing indigenous knowledge and traditions associated with local agro-biodiversity, these projects aimed at recognizing and strengthening the ethnic, cultural and social value of native cultures. However, solid findings regarding impact and adoption are seldom available. Key informants stressed that an evaluation and systematization of results in terms of conservation and livelihoods is necessary to raise awareness of the links between these concepts and strengthen actions directed at their improvement. In fact, the analysis of project reports and interviews showed that among the main obstacles to adequate adoption and dissemination of project results were the lack of systematic impact assessments, the sudden withdrawal of funds and support by donors when the end of the project has been reached, and limited dissemination because the results achieved were not easily replicable or because they were limited to single communities for lack of funding and time to implement them elsewhere.

C. Network analysis

Research and development projects often rely on a network of partners that work on different scales (from the local to the global) and levels across the project impact pathway. Through partnerships, implementers are able to achieve goals that would have been beyond the scope of a single institution working in isolation. Partners also bring their own informal networks and contacts to support the established partnership. Thus universities, national and international research centres, local and international NGOs, community based organizations, the private sector and international organizations can all cooperate within the same project for the achievement of the grant's final impact, playing, however, very different roles determined by their diverse nature and degree of power in influencing the process.

Understanding the network's structures, depicting the degree of the actors' interaction, their roles in influencing and determining the final results, and assessing any transfer of influence from the project implementers to the local community are thus crucial exercises for determining the real impact of any research or development project. Network analysis is therefore an important step that should be included in any *ex ante* analysis, and the transfer of capabilities from one actor to another (ideally from the global to the local) should be assessed *ex post* as an integral part of any impact assessment analysis. Table 3 presents a list of questions we might be able to answer in conducting network analysis both for *ex ante* and *ex post* impact assessment.

Table 3: *Ex ante* and *ex post* analysis of networks

	Ex ante analysis	*Ex post* analysis
What can a single actor bring to the project's network?		
How can each actor influence the project's implementation?		
Is there any actor directly or indirectly involved in the project that might have different goals from the rest of the group?		
Do you need to strengthen the links with an influential potential supporter (high influence, same goals)?		
Can increased networking help empower your disempowered beneficiaries?		
Can we measure a change or transfer of knowledge from one actor to another?		
Has the network facilitated the degree of farmer's adoption of the introduced technology?		
Has the degree of cooperation and its efficiency increased among actors?		

Conducting network analysis *ex ante* and *ex post* is an exercise that should be embedded into projects since their inception and the required budget should also be included. The participatory nature of the exercise is fundamental since a network's linkages, its dynamics and any given change in within it over time should be assessed by all actors involved during *ad hoc* workshops.

In our case studies we analyzed the networks of six projects only *ex post*, since *ex ante* data and information were not collected. The scope of our work, which could not be conducted in a participatory way given the time elapsed since the projects ended and the lack of funding, focuses only on interviews conducted electronically with the project grant managers and project reports made available to us. Therefore we are missing an important amount of information that could have been provided to us by the rest of the actors involved in the projects. However, we believe that our analysis can still provide interesting insights that increase our understanding of the structure of the networks established by each project, the predominant link upon which the network is based and the degree to which actors influence the achievement of project outputs and outcomes.

The measures of interest for our study regard the concept of network centrality, meaning the position of an actor inside its network, given its reciprocal or univocal relationship with other actors. One can measure ***centrality***[6] by its degree, its closeness, and its "betweenness.[7]" In our analysis, we

[6] The degree ***centrality*** of a point is the number of other points to which it is adjacent. It represents how much an actor is well-connected, how many 'choices' it has received and therefore how central it is in the network. It is a measure of local centrality because it ignores the indirect connections the point may have.

do not apply the closeness measure because we are analyzing the network from the point of view of the implementing institution and we lack sufficient information on the relationship between all the different pairs of actors in the network[8].

In our analysis we defined the relevant links in the network according to four categories:

- Money: these include the links based on financing from an actor to another, e.g. from the donor to the grant managing institution, or from the latter to the institution that carries out activities on field
- Research: links based on the providing research activities from one actor to another, e.g. a university carries out laboratory analysis for the implementing institution
- Training: links based on capacity building activities given from an actor to another, e.g. training in food preparation given by the implementing institution to a community
- Exchange of information: this category includes all the links based on simple interaction between two actors who exchange relevant information related to the project or who participate in the same workshops, conferences, seminars.

To define influence of an actor in the network we asked the key informant from the implementing institution to gauge the intensity of the relationship with each actor involved in the network on a 1 to 4 scale. In this way we understand which actors have contributed more to the achievement of relevant project outputs and outcomes.

In order to address the three issues above (structure, links and influence) we collected data from key informants of the implementing institution of each project and from the available project reports. Typically, data should be collected from every network member through participatory activities or through questionnaires. However, due to the extent of the research and the lack of funding to carry out such concerted efforts, we had to rely on the information provided by the grant manager of each project. Therefore we used two sources of data:

- *Secondary data from project reports*: Through these data we mapped out all the actors involved in each project and their direct or indirect linkages to other actors in the network. From this analysis of secondary data an overview of the relationships between different actors involved in each project and of the eventual interactions between different projects was developed.
- *A survey of key project informants*: The survey was submitted to project leaders in order to validate and complement the information on the actors involved. We asked respondents to add other actors relevant to the project in case they were missing. The survey asked whether the relationship between the implementing institution and the other actors was direct or indirect; what services were provided to and received from these institutions (money, research, training etc.); and the intensity of the relationship with each institution involved in the project.

The information obtained from key informants was cross-checked with secondary data from reports and updated in order to obtain a final matrix of actor-by-actor relationships that accounted for the direction, the type and the intensity of the relationships.

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[7] ***Betweenness*** is the degree to which an actor is an intermediary between two other actors inside a group. It is a concept based on local dependency: a point depends on another if the paths that connect it to other points pass through this specific point.

[8] Closeness centrality represents global centrality or the centrality of an actor as being as close to any other point in the graph. A point is globally central if it lies at short paths or distances from many other points.

Network Analysis Results

From the network analysis we gathered some interesting insights into the type of partnerships and actors involved in the six on-farm conservation projects we analyzed in the Andean region (Table 4):

Table 4: Types of Partnerships and Network Structures

Project Title	Type	Network Structure		Predominant Links	Number of influential actors	Total number of actors
		Degree Centrality*	Betwenness Centrality**			
BIOVERSITY-NUS	Research for Development	High	Medium	Research Exchange of information	4	37
SINARGEAA	Research for Development	High	Medium	Research Exchange of information	6	31
LUPIN/QUINOA	Research for Development	Medium	High	Research Training Exchange of information	9	29
COMPLEMENTARY CONSERVATION	Rural Development	Low	Medium	Training	4	15
NATIVE POTATO	Rural Development	Medium	High	Training Exchange of information	7	17
ANDEAN TUBERS	Research for Development	High	High	Training Exchange of information	5	21

* Low degree centrality: 0 to 33,3%. Medium degree centrality: 33,3% to 66.6%. High degree centrality: 66.6% to 100%

**Low betweenness centrality: 0 to 33,3%. Medium degree centrality: 33,3% to 66.6%. High degree centrality: 66.6% to 100%

Network centrality differs from project to project, however it is rather high both in degree and betweenness. Most project activities are developed by the implementing institution with few main partners, usually in a centralized network with one or two focal points.

The type of link prevailing in the network is “exchange of information”: dissemination activities were in fact carried out by all projects and include both sharing information with single institutions and organizations and promotion events that link different actors. Research for development projects seem to focus on research activities with universities and private institutions, while projects aimed at rural development focus on training activities and dissemination of information.

There seems to be an association between the nature of the implementing institution and the nature of influential actors. This might be due to the network contacts from which the implementer chooses its partners. For instance, when the implementing institution is a university or a national research institute we find a strong focus on research activities implemented with other universities or research institutes; on the other hand, we find that public sector institutions tend to attract other public institutions as their main partners. Half of the projects involved universities among their main partners: collaborations are strong especially in terms of academic research, students training and knowledge transfer. This kind of collaboration seems beneficial both in increasing the research capability of implementing institutions and in providing opportunities for universities to gather data and training students as part of larger research or development projects. International organizations have a significant role in all the projects studied as they leverage resources, provide technical assistance, capacity building, and sometimes research activities. Finally, national institutes are present in five out of six projects, a fact which points to an interest in this kind of projects at a public

level. These institutions usually provide funding, but in some cases they also offer technical assistance and capacity building.
The majority of institutions involved in the projects have livelihood improvement as their main goal. Some general limitations of network analysis must however be taken into account. Provan and other authors (Provan et al., 2005) argue that while network analysis is useful to visualize and formalize through mathematical analysis the structure of connections and relationships among institutions, it does not substitute for a complete and overall analysis of why a network is more or less effective. On a different level, Borgatti (Borgatti, 2005) points out some limitations inherent to centrality measures due to the implicit assumptions they are based on. Closeness and betweenness measures, for instance, assume that whatever flows through the network only moves along the shortest possible paths. Furthermore, betwenness centrality is based on the assumption that the resources that flow between nodes only take one specific path or another as if they were indivisible. However, these criticisms do not really affect our analysis because the type of flow process we are studying is that of 'Packages', as defined by Borgatti. In a package flow process there is a fixed destination or target (in our case, a specific actor) and the actor that delivers the package usually chooses the shortest path to do so.

The social networks of all six case study projects have been mapped and are given in Figures 6-11 in Annex A of this research report.

D. Field surveys

The quantitative analysis comprised two components, the first of which is a descriptive part based on the surveys characterizing the households in the sample in socioeconomic terms by reporting frequencies, means and standard deviations of key relevant variables. This analysis also paid particular attention to the interventions applied by each of the projects, the rates of participation, adoption and how these were evaluated by farmers.

The field studies were carried out on the sub-set of six case studies to obtain a quantitative assessment of the implementation and outcomes of the projects. Data drawn from focus group discussions and a household-level questionnaire with a sample of project participants and non participants in the project implementation areas were collected.

The sampling framework had to be adjusted to the conditions of implementation of each project, since each project had its unique aspects. Table 5 presents the specific sampling used in each project, including the sample size and the number of villages where the studies took place. In five of the six cases, the sample was drawn randomly from two populations, those who participated in the projects and those who did not participate, resulting in a stratified random sample based on stratification by participation. In one case, the sample was drawn randomly from the population in the areas where the project took place without an *a priori* distinction between participants and non-participants. The samples are representative of the population for the project sites, though the scale varied by project, but they vary in size, proportion of sample relative to the population and proportion of participant and non-participant households.

Table 5: Sampling used in the six studied projects

PROJECT	Number of communities	Total number of families	Sample size	Participants	Non participants
Ecuador					
UNORCAC[1]	35	2728	175	87	88
INIAP[2]	4	655	100	na	na
Peru					
CRIBA[1]	5	326	120	46	74
ITDG[1]	4	370	130	40	90
Bolivia					
Bioversity[1]	2	260	162	59	105
SINERGEA[1]	2	221	164	27	135
Total	52	4560	851	259	492

[1]Random sample drawn separately from participants and non participants in each community

[2]Random sample from the population without distinction of participants and non participants

Unfortunately, no baseline (or end line) data were available for the studies, nor control sites (sites similar to the intervention ones but where no project activities were carried out except for a baseline and end line surveys). Participants and non-participants were randomly selected from the intervention sites, the latter to serve as "controls." We are keenly aware of the limitations of this approach (potential lack of comparability between participants and non participants and hence biases in the results); however, given the limitations of the studies this was the most feasible approach available (and as will be shown below, we tried to correct for biases through the use of econometric techniques). The questionnaire included information on several socioeconomic, locational and environmental confounding factors that were used to correct for observed differences[9] among the two groups. This is further discussed in the section on econometric methodology (p. 36).

The questionnaire elicited information on: (1) family demographics, education, occupations, and migration; (2) land tenure, landholdings and plot quality; (3) gender; (4) animal holdings and ownership of agricultural assets; (5) access to information and social networks; (6) participation in government and non-governmental programs; and (7) housing and access to public infrastructure. For each project, the specific interventions were previously identified and a module was used to compile information on participation in the projects, and to rate their usefulness and determine whether or not they have been applied. In addition, and depending on the nature of the project, there were specific modules on crop diversity, crop consumption, crop management and perceptions of well-being. These modules were adjusted according to the diversity and livelihood outcomes that each project aimed to achieve.

[9] Clearly we are not able to control for unobserved difference and this is a limitation of this study.

Interventions: participation, assessment and application: Table 6 presents the results of participation in project interventions and adoption of associated innovations among the six projects studied. Each project implemented between 13 and 22 interventions, and the results show that when designing the study the *a priori* information on the rate of participation was widely underestimated. The reason was that most interventions were open to everyone who wanted to participate and records of this type of participation were not kept. The observed rate of participation hence was much higher than originally expected for all projects. Particularly for projects in Peru, almost all households sampled participated in at least one intervention, while in the other projects it varied between 45 and 66%. As it will be discussed later, this has implications for assessing the links between project participation and perceived benefits in the Peru projects. Participation was not only higher than expected but on average households participated in more than five interventions. The rate of adopters (number of households that apply an innovation provided by an intervention/ number of participants) was also quite high for all projects, particularly for UNORCAC, where this is higher than total participation by 50% and indicates large spillovers to non-participating households (although this is the only case of spillovers). The mean number of innovations adopted is also high; about half of the number of interventions where farmers participated. Finally, all of the innovations adopted were rated at least as "useful" (rate=4) by 50 percent of the adopting households. Given the levels of participation, adoption and ratings of usefulness, and particularly if adoption as an outcome is considered a criterion of success, one can conclude that all projects studied were very successful. This point is illustrated in the graph in Figure 12 in Annex A.

PROJECT	Cotopaxi[2]	UNORCAC[1]	CRIBA[1]	ITDG[1]	Biodiversity[1]	SINARGEAA[1]	Total
No. interventions/project	13	22	13	15	16	13	92
Sample size	100	176	120	129	162	161	848
Ex ante participants	na	96	44	40	56	25	261
Ex ante non-participants	na	80	76	89	106	136	488
Ex-ante rate of participation	Na	0.55	0.37	0.31	0.35	0.16	0.31
Observed non-participants	48	60	15	2	76	89	290
Observed participants	52	116	105	127	86	72	558
Rate of participation	0.52	0.66	0.88	0.98	0.53	0.45	0.66
Mean number of interventions participated	5.7	7	7.7	6.1	8.0	7.9	7.1
Observed adopters	46	174	95	114	76	52	557
Rate of adoption/participation	0.88	1.50	0.90	0.90	0.88	0.72	0.89
No. non-participants that adopted	0	58	0	0	0	0	58
Mean number of interventions adopted	4.2	5.4	4.9	3.7	3.96	3.85	4.5
Median rating of usefulness of intervention	4.9	4.3	4.1	4.0	4.0	4.0	4.1

Table 7 shows that there were a total of 92 interventions across all six projects. Interventions were grouped into thirteen themes depending on their aim and then counted (Panel A). Not all themes were present in all projects, but each project has a combination of these interventions, and each theme grouped between one and six interventions. The most common set of interventions had to do with collecting, characterizing the diversity of native species and varieties (which generated new knowledge to farmers and scientists about the crop diversity available) and providing farmers with access to both local and introduced varieties through seed fairs, production and distribution of seed and other mechanisms. The second most common set of interventions had to do with training interventions that provided knowledge and practices on different aspects such as agronomy, consumption, diversity and pests and diseases. The third type of interventions was related to new forms of farmer organizations, including the formation of local research committees (CIALs) or strengthening local organizations for better marketing. Interventions related to agronomic practices, improving marketing and better management for pests and diseases were the fourth most common sets of interventions. There were interventions that were project-specific, such as the *kamayoq*, a type of local extension agent that provided technical advice to farmers or interventions related to improving soil fertility, irrigation, processing or storage.

The lesson to be learned from this analysis of the number and types of interventions is that projects typically present a basket of interventions that provide farmers with different types of innovations with different aims, providing practitioners with the opportunity to choose from them, those innovations that best fit the needs of their own situations.

Table 7: Number of interventions, participants and adopters grouped by theme of the intervention

	Ecuador		Peru		Bolivia		
Theme	INIAP	UNORCAC	CRIBA	ITDG	Bioversity	SINARGEAA	Total
			Number of interventions				
diversity	4	5		2	4	4	19
agronomy	1	1	2	5			9
pests & diseases	1		4	2			7
fertility				3			3
irrigation		2		1			3
kamayoq				2			2
consumption	2	1					3
storage			1				1
processing	1	1	2				4
marketing	1	1	1		2	2	7
training		4	2		6	5	17
organization	3	3			1	1	8
dissemination			1			1	2
agritourism		4			3		7
Grand Total	**13**	**22**	**13**	**15**	**16**	**13**	**92**

The theme "training" comprises training in different aspects that correspond to some of the other identified themes: agronomy, consumption, diversity, and pests and diseases.

Diversity and Socioeconomic Analysis

Table 8 presents some basic crop diversity indicators for the projects and target species under examination. It shows that while there is diversity of both crops and their varieties, there is also variation across projects. The UNORCAC project reported the highest inter-specific diversity of all projects, which included not only native crops, but also herbs, fruit trees, agroforestry species and non-domesticated species collected from the wild; while the INIAP project had the lowest diversity. Many of the target crops of one project were also grown in others, such as potatoes—grown in most projects and exhibiting great infra-specific diversity— and other native crops, which is not surprising given that the projects were located in centers of relevant diversity by design. For project target crops, many farmers grow them and maintain infra-specific diversity, although clearly there are some species that are more common and with higher infra-specific diversity than others. These data confirm the crop diversity present in project sites and maintained by farmers and their households.

Table 8: Indicators of crop diversity in the six studied projects (numbers in bold indicate target crops for the relevant project)

	Ecuador		Peru		Bolivia	
Indicator[1]	INIAP	UNORCAC[2]	CRIBA	ITDG	Bioversity	SINARGEEA
Total number of crops reported	2	137[3]	11	2	13	13
Mean number of crops/hh	1.4	**36**	2.2	1	3.7	3.4
Mean number of varieties/crop/hh	1.1	**1.2**	7.3	11.9	15.9	11.9
Quinoa (*Chenopodium quinoa*)						
Farmers planting (%)	**48**	22.7			**76.5**	**88.2**
Mean number of varieties/hh	**1.1**				**1.8**	**2.4**
Canahua (*Chenopodium pallidicaule*)						
Farmers planting (%)					**51.9**	**4.3**
Mean number of varieties/hh					**1.7**	**2.3**
Lupinus (*Lupinus mutabilis*)		18.2				
Farmers planting (%)	**95**					
Mean number of varieties/hh	**1.1**					
Oca (*Oxalis tuberosa*)						
Farmers planting (%)		6.3	**40**		16.7	16.8
Mean number of varieties/hh			**1.9**		3.2	2.4
Ulluco *(Ullucus tuberosus*)		6.8				
Farmers planting (%)			**57.5**		2.5	2.5
Mean number of varieties/hh			**2.1**		2.3	2
Maswa (*Tropaeolum tuberosum*)						
Farmers planting (%)		2.8	**19.2**		1.2	2.5
Mean number of varieties/hh			**1.5**		2	2.5
Potatoes (*Solanum tuberosum*)						
Farmers planting (%)		52.3	**95**	**98.4**	99.4	97.5
Mean number of varieties/hh			**3.5**	**11.9**	11.1	7.2

[1] Means were calculated for only for those who grow the crop

[2] Data on infra-specific diversity not presented due to difficulties in calculating them by specific crop

[3] These data refer not only to crops, but include not only different cultivated species, but also fruit trees, herbs from home gardens and agroforestry species, as well as some species collected from the wild.

Table 9 presents key socioeconomic indicators from households in the studied projects. It shows that more than half speak indigenous languages associated with local ethnic groups, which suggests a cultural link to native crops and associated traditional knowledge. Even among primary Spanish speakers these links may still persist. Most households are male-headed, but in some projects, female-headed households make up a sizable proportion of the total households. In general these are middle-aged farmers, but average family ages indicate that there are still young people living in

them, although in Bolivia households seem much older than elsewhere. Average family size is quite homogenous across projects, and although there is temporary migration, this still relatively low. Landholdings are obviously central for agricultural populations and the basis of their ability to provide themselves with food and income. The data show, however, that these landholdings are quite small, particularly in the cases of UNORCAC and SINARGEA projects, and while landholdings are larger in Peru-based projects, in all cases land seems to be quite limited, suggesting constraining agricultural conditions. Farmers in these environments face many risks and have limited access to financial services for saving, investments and risk management, hence domesticated animal holdings are an important means for addressing these shortcomings, particularly when different species are owned. Data show that farmers own on average between three and four different species of animals. This number can be a good indicator of farmers' wealth (akin to a diversified portfolio of shares and bonds). Another increasingly important factor in rural livelihoods is the role of endogenous and exogenous organizations as a way of gaining access to private and public goods and services. The mean number of organizations known to a household is a good indicator of social capital and initiative to participate in collective endeavors; the data show that except for the case of UNORCAC, many households do not know about organizations, suggesting a limited amount of social capital among them. Sources of income outside a farmers' own agricultural efforts are increasingly important and relevant for rural livelihoods. A majority of these households obtain income from diversified sources, mostly from non-farm labor, although remittances, both national and international, are limited among them. These data, together with that on crop diversity, suggest quite diversified livelihoods among the studied households in terms of crops, animals and sources of income. The socioeconomic indicators described here are included in the econometric section as confounding variables to correct for possible biases in the results.

Table 9: Key socioeconomic characteristics of studied farmers and households

Indicator by household	INIAP	UNORCAC	CRIBA	ITDG	Bioversity	SINARGEEA
Language commonly spoken (%)						
Spanish	52.0	35.8	24.2	31.0	43.2	47.8
Quechua	19.0	34.1	75.8	69.0	0.0	0.0
Aymara	0.0	0.0	0.0	0.0	56.8	52.2
Sex of head (female)	28.0	32.4	5.0	10.9	19.8	13.7
Age of head (years)	45.3	47.6	43.2	45.0	63.1	55.7
Age of the household (years)	29.0	31.2	27.6	29.9	51.7	42.7
Education of head (years)	3.9	2.9	3.0	3.1	2.8	3.0
Family size (number)	4.6	5.2	4.4	4.2	4.1	4.6
Household with migrants (%)	1.0	0.0	6.7	11.6	16.7	16.2
Total landholding (ha)	1.7	0.7	2.3	2.4	1.8	0.6
Mean number of domesticated animal species own	4.4	3.4	4.5	3.6	3.5	4.0
Mean number of organizations known to hh	0.8	2.4	0.9	0.7	0.7	0.7
Mean sources of income outside own agriculture	1.0	2.5	0.8	0.8	0.8	0.7
at least one source	68.0	98.3	53.3	50.4	64.2	54.0
off-farm labor	36.0	50.0	14.2	19.4	1.2	4.3
non-farm labor	35.0	89.2	39.2	21.7	20.4	23.0
business	11.0	14.8	5.8	18.6	8.0	14.9
remittances-national	3.0	4.0	2.5	3.9	0.0	0.6
remittances-international	2.0	2.3	0.0	0.0	1.2	0.0

E. Econometric analysis

The field surveys comprised one component of the quantitative methodology. The second component comprised an econometric analysis to test whether each of these six projects can be considered successful based on the concepts presented in the Conceptual Framework section. As indicated there, assessing the success of an on-farm conservation project requires answering at least three questions[10]:

1. Do farmers apply the innovations provided by project interventions?
2. If so, does the application of these innovations lead to farmers maintaining levels of crop diversity higher than would have been possible without them?

[10] As indicated earlier answering the fourth question while important is not feasible yet due to our limited understanding of the relationship between crop diversity and evolutionary services. As indicated later this was addressed by the location of projects.

3. Does this higher level of crop diversity lead to increased well-being among the households of farmers who applied the innovations?

Answering positively to these three questions will indicate that a project was presumably successful. Ideally one would assess whether the project has achieved the intended changes in the short- or medium-term and attribute these changes to the project interventions. A major consideration for this assessment is to identify the changes that would have occurred without the interventions, known as the counterfactual. Reality is dynamic and complex, with many processes taking place simultaneously and affecting each other, hence observed changes could have happened due to factors that are independent of project interventions (known as confounding factors), either masking or exaggerating project impacts and thus the need for the counterfactual as a comparison to elucidate more accurately the changes (and their magnitude) that can be properly attributed to project interventions. Establishing the counterfactual implies that we account for both observed and unobserved intervening factors and for so-called contemporaneous events. These are events that occur during the implementation of the project and that influence the outcome.

Theoretically the problem is presented following the framework of Rubin (1974): an individual may occupy two potential states, only one of which is realized for any person. Y_1 being the outcome of the project when that individual received treatment and Y_0 the outcome if the individual did not receive the treatment (did not participate in the project), for the generic *i-th* individual the project benefits result from:

(1) $\Delta_i = (Y_{i,1} - Y_{i,0})$.

In practice Δ_i cannot be explicitly evaluated, because the *i*-th individual cannot be involved in both states (participation and non-participation). By comparing participants of the project to non-participants we do not avoid this problem because there may have been differences between both groups at the outset of the project that explain, at least partially, the outcome. This is known as "selection bias."

Selection bias can be avoided by randomly assigning groups of individuals to different conditions of project interventions (e.g. villages), including no intervention—i.e. a control group—and using group statistics, such as the mean, instead of data on single individuals (Heckman 1997). This should guarantee that the intervention and control group start out with the same conditions (Cook, 2000). Random assignment experiments have gained great support in development circles lately (e.g. Banerjee and Duflo 2011), however, this approach also has technical limitations (Barahona 2010; Deaton 2010) and has raised certain social and ethical concerns (Stern et al. 2004). Alternative non-experimental methods using statistical tools, such as selection models (Heckman 2000) are available. A type of these methods relies on comparing differences within and between groups, such as within the same group before and after interventions take place, or within and between participant and non participant groups before and after interventions take place. Using these methods requires a careful design and collection of data before (baseline) and after interventions take place. Another type is the method of instrumental variables, which takes into account the potential presence of correlation between the participation and the unobserved components that may influence the participation (Caliendo and Hujer 2006). It consists in identifying a variable which determines treatment participation without directly influencing the outcome. The causal effect among treatment and outcome can be identified exploiting the variation in the selected instrumental variable.

In the case of the six projects analyzed here, and because project interventions were not assigned randomly between treatment and control groups, there were no *a priori* control groups and no baseline available, the instrumental variable method had to be used to analyze whether these projects can be deemed successful or not. This requires the development of indicators for: (a) adoption of project interventions, (b) crop diversity and (c) benefits associated with household well-being.

As presented earlier, project interventions were many and comprise multiple aims, that is, a "basket" of research-based and development-oriented activities. The simplest indicator, and the one used here, is the number of innovations provided by project interventions adopted (applied) by a household. This indicator also takes into account both the potential indirect effects due to spillovers (participation and adoption was greater than expected from records of participation) and the evidence that often the innovations associated with interventions were already applied by households, which the projects only helped to promote. This indicator, however, also has limitations, particularly as it does not allow the assessment of which interventions or types of interventions were more influential than others since the index is only quantitative and does not distinguish by individual intervention or type, but it does have the advantage of being simple, and easily interpretable.

The indicator for crop diversity was derived from the number of varieties of target crops planted by households in each project, so in fact is a measure of richness. Since in all projects there were multiple target crops, a factor analysis was perform on the number of varieties of each target crop per household in order to obtain a reliable univariate measure of crop diversity and the result,[11] the predicted factor, was used as the indicator. Factor analysis is a statistical variable-reduction technique that captures most of the available information contained in multiple variables as a linear combination of them.

As indicator of benefits associated with household well-being, we use slightly different ones depending on the case study by country:

a) In **Ecuador**, for the UNORCAC project we summarize information provided in the survey on a household's life satisfaction and on nutrition and food security (meat and fruit and vegetable consumption) using factor analysis. The life satisfaction index was derived from a series of ratings on the level of satisfaction experience by the household with respect to different variables such as housing, access to education, economic activities, social life and contacts, as well as nutrition and food security[12]. For the INIAP project we use the quantity of lupin and quinoa consumed by the household from its production; since selling prices were available, we calculated the gross revenues from marketing.

b) For **Peru,** we use the quantity of target crops consumed and marketed by the household from its production; if prices were available, we calculated the gross revenues from

[11]Given that many farmers planted several varieties in one plot and hence a specific area could not be associated with a specific variety, available data cannot allow us to calculate other types of diversity indices that take into account both richness and evenness, such as the Simpson index.

[12] We used this index because given the high diversity of crops, many perennial, it was very difficult to create an index based on consumption and marketing. Furthermore, the UNORCAC partner explicitly requested the use of this index.

marketing. The target crops were: potatoes (**Peru – ITDG**) and potatoes, *olluco*, *oca* and *mashua* (**Peru – CRIBA**).

c) For **Bolivia**, we use the quantity of quinoa and cañahua consumed and marketed by the household from its production; since selling prices were available, we calculated the gross revenues from marketing.

The processes of the adoption of a basket of innovations provided by multiple interventions by a household, its management of crop diversity and the levels of well-being it experiences are complex and are influenced by many different factors simultaneously which in turn can hamper the identification and measurement of the relationships among these three processes, and hence have to be taken into account and corrected for in order to be able to answer these three questions correctly. These confounding factors include farmer's characteristics such as ethnicity, age, and education; agro-ecological conditions; agricultural assets; labor availability including migration; sources of income (including government transfer programs); social capital (ability to engage and participate in different types of organizations with different purposes); and specific conditions in the communities such as infrastructure, history, political environment, etc. These factors not only reflect local conditions and processes, but also global trends. For example, increasingly migration, remittances and non-farm sources of income have become a reality of rural livelihoods, with rural households having quite diversified livelihoods in terms of sources of income, crops and domesticated animals. While many of these factors may influence all of the three processes of interest, there may be some that are only important for some, i.e. agro-ecological heterogeneity is particularly important for decisions concerning crop diversity.

The conceptual framework also identifies the public benefits associated with crop diversity as a fundamental component of an on-farm conservation project. These benefits are taken into consideration by the location of the projects, and this is the way we addressed the fourth question of the framework, though we recognize that is a limited approach but the only feasible one given the limited knowledge about the relationship between crop diversity and evolutionary services. As indicated in the section on crop diversity, not only are the high Andes centers of crop diversity for the target crops, but also there is a high diversity in areas around the target communities (Figures 4 & 5 in Annex A). The relationship between crop diversity and the provision of societal benefits still requires further study.

To address the complexity of assessing three different outcomes, a simultaneous equations system was estimated, including other determinants of participation and outcomes of interest. These variables include several socio-economic characteristics of the sampled, the environment and the location households (the confounding factors mentioned above) and they can be considered fully exogenous, not being affected by participation.

$$\text{Household Benefits}_i = \delta_0 + \delta_1 \text{Crop Diversity}_i + \delta_2 X_{1i} + \ldots + \delta_{1+r} X_{ri} + e_i$$

$$\text{Crop Diversity}_i = \beta_0 + \beta_1 \text{Adoption}_i + \beta_2 X_{1i} + \beta_3 X_{2i} + \ldots + \beta_{1+r} X_{ri} + u_i$$

$$\text{Adoption}_i = \gamma_0 + \gamma_1 Z_{1i} + \gamma_2 X_{1i} + \gamma_3 X_{2i} + \ldots + \gamma_{1+r} X_{ri} + v_i$$

where

Z_1: ex-ante participation in project

X_r: language, age, education, sex of head of household, landholdings, wealth, organizations, labor availability, migration, number of sources of income

Empirically, the model assumes that adoption of project interventions is an endogenous variable explaining native crop diversity, while crop diversity is an endogenous variable that explains the benefits associated with household wellbeing. So adoption of project interventions is an instrument

to identify crop diversity, while the latter is an instrument to identify household benefits. It is assumed that adoption only influences benefits indirectly through its effect on crop diversity. The adoption of project interventions is influenced by whether the household was drawn from the sample of *ex ante* participants or from the one of non participants.

Table 10 shows a summary of the results presenting the coefficients that relate participation in the project, adoption of project innovations, native crop diversity and benefits to the household, which correspond to answering the three questions posed to assess the success of an on-farm conservation project (the complete results including the confounding factors are presented in Table 11). A positive answer to any of the questions posed corresponds to a coefficient that is positive and statistically significant. The results show that in the cases of both projects in Bolivia, which were merged because they were implemented by the same organization (PROINPA)[13], had very similar interventions with same target crops and environments, and the UNORCAC project, all coefficients are positive and significant indicating that the answers to the questions posed are positive and are unlikely to be due to chance. In the case of the CRIBA and ITDG projects, the coefficients are statistically significant only for *ex ante* participation and for adoption (although at a much lower statistical significance), but not for household benefits, which suggests that while adoption of project interventions influenced (positively) the level of native crop diversity, there is no evidence that the level of native crop diversity influences household benefits. Finally, for the INIAP project there is no evidence of the influence of adoption of project interventions on the level of native crop diversity, and neither of the latter on household benefits.

Discussion of results of econometric analysis

Our results show that there is plausible evidence that at least three of the projects analyzed can be considered successful. There is evidence of a link between *ex ante* participation and application (adoption) of project innovations in all projects, and in two there is evidence, albeit weak, of adoption influencing the level of native crop diversity planted by a household, but no link to household benefits. So in two of the projects we only have partial evidence for success. The lack of evidence of this last link could be because in fact there is no link, but could also be due to a lack of statistical power associated with the relatively small size of sample used.

It should be pointed out that a limitation of our empirical approach is that for the projects with statistically significant results, strictly speaking we have not shown that the projects as such work, just that the interventions associated with them did. This is because we are using *ex ante* participation as the instrument for adoption. However, there is no guarantee that *ex ante* participants and non participants were not originally different and the differences observed have to do with other unobserved factors rather than with project participation. The lack of a baseline hampers our ability to carry out such comparison and because participation happened in the past and we only have data from the present, the use of any instrumental variable measured during the survey to explain participation will be using a variable from the present to explain the past, unless we used recall data or variables where the present is highly correlated with the past. These limitations illustrate the crucial importance of having a good design and data gathering component from the onset of the project.

Our approach has established a plausible link between the application of innovations provided by interventions promoted by projects aimed at on-farm conservation and crop diversity, and from the

[13] In the empirical model a dummy variable was included to distinguish between both projects. Merging them increases the sample-size, reducing "finite sample" bias. The latter will reduce the estimation precision of instrumental variable models when the instruments are weakly correlated with the endogenous explanatory variable (Bound *et al*., 1995)..

latter to household benefits at least in three of the projects studied. In any case, most of the project interventions would not have been available without the projects being implemented in the study communities. Furthermore, we observed an incremental response between the level of application of project innovations (each additional application of an innovation had a positive effect on the level of crop diversity) and the level of native crop diversity and between the level of diversity and the indicator of well being, providing additional evidence of the plausibility of these links. While we may not have been able to establish exactly which interventions may have been more influential than others, it is not clear whether an assessment by individual intervention or type may be meaningful if there are interactions among interventions and hence there is systemic rather than individual effects. This is beyond the current scope of this report, but merits further attention in the future.

In spite of all these limitations, our approach has provided a conceptual framework to guide what to measure and what links to test empirically the plausibility of the success of an on-farm conservation project -- not a small feat given the complexity of the processes analyzed and the limitations of the data available.

Table 10. Summary results of the estimation

	Adoption	**Native Crop Diversity**	**Household Benefits**
		UNORCAC	
Ex ante participation	**3.34766** ****		
Adoption		**0.1775699** ****	
Native Crop Diversity			**0.609038** ***
		INIAP	
Ex ante participation[2]	**1.23050** **		
Adoption		0.0146095	
Native Crop Diversity			-30.14413
		CRIBA	
Ex ante participation	**1.734173** ***		
Adoption		**0.1835637** *	
Native Crop Diversity			-1669.148
		ITDG	
Ex ante participation	**0.95421** **		
Adoption		**0.2889878** *	
Native Crop Diversity			467.9104
		Bolivia[1]	
Ex ante participation	**1.908434** ****		
Adoption		**0.0337049** ****	
Native Crop Diversity			**497.0055** ****

Note: *, **, ***, ****, significant at the .10, .05, .01, .001 level respectively

[1] The two projects in Bolivia, SINARGEEA and Bioversity/PROINPA were merged because they included very similar interventions, were implemented by the same institution PROINPA. A dummy variable was added to take into account project-based differences.

[2]In the case of INIAP, the sample was not stratified by *ex ante* participation due to lack of available information. However, discussions with implementers indicated that being part of a protestant church played a key role in participation, so a response mentioning a church in the section on social organization was used as the instrument for the adoption equation.

	UNORCAC		INIAP		CRIBA		ITDG	
Adoption								
Ex ante participation[2]	**3.34766**	****	**1.230504**	**	**1.734173**	***	**0.95421**	**
Spanish	-0.49387		-0.4187		0.431237		-0.44995	
Sex household head	0.093108		0.115553		-1.03594		0.151598	
Age head of household	-0.00805		0.07012		0.021163		-0.01428	
Education head of household	0.121262		-0.00049		**0.274804**	*	-0.06465	
Migration					-0.20352		-0.36053	
Labor availability	-0.00594		**0.026207**	**	0.007487		-0.001	
Landholdings	**0.284182**	*	**0.397629**	***	0.124079		0.022237	
Wealth	**0.501767**	****	-0.06751		0.159382		**0.249573**	*
Organizations	0.098798				-0.13109		**0.745063**	****
Sources of income	0.118582		0.01742		0.085318		**0.002977**	***
Region 1	0.643269		**-2.44615**	***	**-2.78148**	****	**-0.00747**	***
Region 2	**1.85804**	**	-1.82814		**-2.0678**	**	-0.23369	
Region 3	0.115199		**-2.34996**	**	**-1.53231**	*	0.244972	
Region 4	0.319629				-1.14176			
Region 5								
Project[1]								
Constant	1.246152		1.103624		1.705106		**2.582811**	**
Native Crop Diversity								
Adoption	**0.17757**	****	0.01461		**0.183564**	*	**0.288988**	*
Number of plots	0.026467		0.0679		-0.00387		0.027639	
Spanish	**-0.30662**	**	-0.01971		**-0.41995**	**	0.24357	
Sex household head	**0.286511**	**	**-0.38112**	**	0.310041		0.031242	
Age head of household	0.002853		-0.00913		0.003733		0.000732	
Education head of household	0.008888		-0.03338		-0.0513		-0.00505	
Migration					0.189087		0.095662	
Labor availability	0.002864		-0.00241		0.003187		0.003452	
Landholdings	0.011739		0.026042		0.026635		-0.00756	
Wealth	**0.109133**	**	0.076094		-0.06273		-0.0085	

Region 1	**-0.39198**	***	-0.11658		0.296514		-0.20007	
Region 2	**-0.47064**	*	**-0.94649**	**	-0.21821		-0.2563	
Region 3	**-0.43163**	**	**-1.25576**	***	0.06862		-0.07167	
Region 4	-0.17702				-0.07728			
Project[1]								
Constant	-1.46322		0.793544		-0.99242		-0.63084	
Household Benefits								
Native Crop Diversity	**0.609038**	***	-30.1441		-1669.15		467.9104	
Spanish	0.160509		-44.9268		-382.228		10.61775	
Sex household head	-0.293		-23.2624		-386.526		-163.383	
Age head of household	**-0.01598**	***	-1.90942		11.60431		12.42754	
Education head of household	-0.03189		21.12796		127.1307		**193.5843**	*
Migration					53.7661		-46.1874	
Labor availability	-0.00315		1.276376		33.92963		7.273295	
Landholdings	0.018474		19.33782		**252.1969**	**	31.27232	
Wealth	0.066843		30.84602		96.40613		-48.5669	
Organizations	-0.15555				-278.102		**312.454**	**
Sources of income	0.025605		18.803		**-614.507**	**	**-278.696**	*
Region 1	0.045103		-149.752	*	-755.432		349.1076	
Region 2	-0.4615		-414.578		-474.836		-665.481	
Region 3	0.407078		-392.163		-333.064		**-731.306**	*
Region 4	0.412959				-785.964			
Project[1]								
Constant	1.073672		315.0276		-526.514		380.2374	

Note: *, **, ***, ****, significant at the .10, .05, .01, .001 levels respectively

[1] The two projects in Bolivia, SINARGEEA and Bioversity/PROINPA were merged because they included very similar interventions, were implemented by the same institution PROINPA. A dummy variable was added to take into account project-based differences.

[2] In the case of INIAP the sample was not stratified by *ex ante* participation due to lack of information available, however, discussions with implementers indicated that being part of a protestant church play a key role in participation, so a response mentioning a church in the section on social organization known was used as the instrument for the adoption equation.

III. Lessons Learned, Resulting Guidelines and Conclusions

A. Lessons Learned

Interventions: participation, assessment and application: One of the main lessons learned from our study concerns the lack of systematic assessment and definition of interventions in the context of a specific project**.** There are in fact some fundamental questions that implementers should address in designing their intervention but seem to be generally overlooked. These questions include:

- What is an intervention? (i.e. what are the activities to be carried out? What are the innovations that these activities will provide?)
- Why there is a need for this intervention: are we doing the right and relevant thing?
- What is the change that this intervention will bring about or what is the effect of the intervention? (i.e. what is the expected result from the application of the innovation that the intervention provides?)
- How will the intervention bring about this change or effect? (how will the intervention and associated innovation generate the envisage change?)

This problem has a dual nature: on one side it concerns defining what is the intervention and why one wants to implement it; on the other it involves defining the expectations that one has on the effects that participating in the intervention will have for the beneficiaries. While these issues may seem obvious, and implementers likely somehow may have them in their minds when designing a project, the issue is that they may be implicit and not examined systematically, but to increase the chance of success and a better assessment of a project, they need to be made explicit and be analyzed systematically. This exercise should be undertaken thoroughly at the beginning of any project because defining what one expects from an intervention automatically involves defining the instruments through which one can achieve this expectation and the indicators of change/progress through which one measures the success of an intervention. Moreover, there is a strong problem of attribution: it is difficult to understand what the effects of the intervention itself are and what would have happened anyway because of an existing trend. The relevant overall questions are:

- What would/would not happen without the intervention?
- Are we introducing something completely new with the intervention or are we creating new ways of disseminating or using existing practices?

The answers to these questions determine different methodologies and different evaluation methods and therefore they need to be properly addressed. Beneficiaries participate in an intervention to which they attach a certain level of usefulness and then some of them apply the innovation provided by the intervention. The rating of usefulness codetermines the rate of application. There might be spillovers to non-participants who deem the intervention useful and decide to apply the innovations learned by participants. Finally, the application of innovations determines changes in local agro-biodiversity while it also determines changes in livelihoods both directly and through changes in agro-biodiversity. Related to participation and usefulness, it was interesting to see that participants and implementers mainly deemed useful the same activities. There seems to be a good understanding of what farmers need and value. We also learned that the definition of a baseline and control group is fundamental to understand unambiguously the change brought about by an intervention.

From the **literature review** a lesson emerged from the fact that there is confusion and vagueness about the definition of impacts, outcomes, outputs and relative indicators which makes the understanding of projects' theoretical approaches (theory of change) difficult. The projects studied seem to have achieved similar outcomes in terms of livelihoods and conservation, although their

focus was different and not always well identified as either research for development or development itself. Moreover, outcomes are general, definitions are broad and it is seldom clear how they were actually achieved and if and how the related change could be measured.

Our analysis is a first step toward the development of a conceptual framework for the inclusion of **network analysis** in *ex ante* and *ex post* impact assessment. In fact, despite the bias and limitations in the way we had to collect information based on secondary and indirect primary data (reports and surveys instead of face to face interviews or workshops), this exercise was very useful in understanding network structure, links and influential actors. In fact, we argue that network analysis represents an interesting method not only *ex ante*, as it was conceived, for mapping out information flow, power structure and bottlenecks in a network, but also as an *ex post* methodology to understand the type and intensity of interactions created in a project and assess the level to which the knowledge transfer, capacity building, network creation and dissemination were successful. Network analysis could therefore be used as a before-and-after analysis to allow comparisons on the network designed at the beginning for the project (to understand which actors can aid or impede the successful development of the project and the channels that would lead to greatest dissemination) and the network outcome at the end (to understand if the network created was successful in linking relevant actors and in effecting dissemination); or it could simply be used as a tool for *ex post* analysis or impact assessment. This is an area that merits further research and application.

B. Guidelines for On-Farm Conservation Projects

The success of any on-farm conservation project depends on a good design that brings together four aspects: (1) crop diversity, (2) the private benefits associated with its use; (3) the societal/public benefits associated with its maintenance; (4) the interventions/innovations needed to link these three areas in a positive and coherent way. In order to do this, we propose a set of guidelines for project design. These guidelines should assist the project implementer in formulating, step-by-step, a sound and solid theory of change that will lead to the achievement of impact.

Step-by-Step for a Successful Project

1. Decide which area to target

A distinguishing feature of an on-farm conservation project is the focus on delivering public benefits associated with the maintenance of crop diversity. Locating a project in an area with a high potential for delivering these types of benefits is crucial, e.g. a center of infra-specific diversity for a crop or a hotspot of co-occurrence of many relevant crops. But even if those benefits exist, the value of implementing projects may still depend on how unique and globally relevant the crop diversity is and the extent to which there are other projects already addressing these benefits in the area (to avoid duplication and waste of resources, but also to be able to learn from those other projects).

2. Collect diagnostic data

The next step is to assess whether farmers in the target area are deriving private benefits from crop diversity, which farmers are doing so, and what the trends are in the provision of these benefits (are they continuing, decreasing, increasing?). In many locations farmers already continue to maintain crop diversity without any outside intervention (known as *de facto* conservation). However, there is no assurance that this may continue in the future and hence there may be a need for outside interventions. For this it is necessary to have a good diagnosis of the incentives for farmers to use and maintain crop diversity. This requires collecting diagnostic data on the level and management of native species diversity *in situ* and *ex situ* as well as on socio-economic issues, focusing on the use of target species in the research area. Diagnostic data therefore include: a literature review or

empirical studies of local diversity status and use; socio-economic surveys; and key informant interviews.

3. Assess the potential for success

If the evidence from diagnostic data indicates that an involvement is desirable, then there is a need to assess *ex ante* whether there are interventions that can be implemented to enhance the incentives that farmers have to use and maintain crop diversity. This is a prospective assessment for identifying the areas where change is needed (areas of intervention), the types of change (interventions) needed and their potential of success based both on the diagnosis and on knowledge from other studies. There are two broad types of potential interventions: (a) those that build on farmers' preferences and actions related to improving production, consumption, and marketing; and (b) those driven by external actions, such as payments for agro-biodiversity services (PACS) or regional or national policies (e.g. eliminating subsidies, promoting purchase programs, etc.)

4. Identify interventions to implement

Once the areas and general types of interventions have been identified, these must be narrowed down to specific activities that need to be undertaken to enhance the incentives that farmers have to use and maintain crop diversity. These activities are the core project interventions aimed at changing the way native crop diversity is managed, used, consumed and marketed to increase the benefits farmers and their households derive (livelihoods) and hence to create the incentives for farmers to continue to maintain this diversity on-farm (conservation). It is likely that several areas of intervention may have to be addressed and therefore there may be a "basket" of interventions in a project. These interventions need to have a clear **theory of change** (see the figure on p.4), which is a narrative describing **why** an intervention is needed, **what** is expected to be changed due to the intervention and **how** the change(s) is/are supposed to have an effect on crop diversity and well-being.

5. Define expected outputs, methodology and partnerships

Project interventions require the development of specific outputs, i.e. novel knowledge, methods, technologies, or forms of organization to be used by project beneficiaries or target groups to generate the envisioned change (therefore can also be conceptualized as innovations provided by a project). Some of these outputs will be related more to diversity, others more to livelihoods, but they have to be complementary. Once the specific interventions have been identified then there is a need to clearly define how desired change to the current situation can be accomplished, i.e. the **methodology** to be used. Once the different interventions and methods have been defined, there is a need to set up a **network of partners** that will enable the project implementation. Therefore there is a need to understand which actors and institutions can influence or support the interventions and how, what their goals and eventual relationships are, and what links and channels are needed to improve collaboration.

6. Map the impact pathway

Once all these components have been defined, there is a need to develop an impact pathway, which is a logical and coherent conceptual chain of events that link all components into a process. The chain of events maps the pathway by which planned outputs are related to interventions and allows the project team to contextualize them. Interventions then are expected to lead to the application and use of the outputs (that may differ from the planned ones due to contextualization) to achieve the desired changes. These in turn should eventually lead to the desired livelihood and diversity outcomes associated with successful on-farm conservation. It is anticipated that by explicitly planning the impact pathway, researchers and partners will be better able to fine-tune the research

design, establish the most effective partnerships and determine the appropriate communications activities for achieving the intended outcomes more effectively.

7. Make planning and implementation activities participatory

It is highly recommended that all the processes described here be made participatory, engaging the research team, partners and clients as a way to develop a more realistic and shared vision of the project/programme and to facilitate feedback, learning and adaptive management. Identifying (and engaging) key partners and describing intended impact pathways will help to focus monitoring, evaluation and impact assessment activities.

8. Collect baseline data

Once information on project interventions and associated outputs, theory of change and impact pathway is available, it is fundamental to carry out the **collection of baseline data** in order to perform a sound impact assessment at the end of the project. The baseline should include indicators associated with the implementation of project interventions and the changes that they are expected to contribute to outcomes. The need to wait until project interventions are defined to carry out the baseline is important because otherwise there will be no way of knowing whether or not the interventions were effective.

9. Translate outputs to outcomes

Once project interventions are implemented, it is expected that these lead to adoption and use of outputs by the target population through **communication and dissemination activities**, in turn resulting in the desired changes (**outcomes)**, in terms of both diversity and livelihoods. Then a process to **scale out** may take place so that populations beyond the target group and stakeholders adopt project outputs through dissemination and **institutionalization** by policy makers and key stakeholders. It is fundamental at this stage to collect endline data which can be then compared to baseline data collected before implementation in order to understand and measure the changes generated by the project in diversity and livelihoods.

10. Assess impact

Through this scaling out and scaling up process, the **expected impact** and the changes that the project set out to create should be generated and the **conservation of diversity while improving livelihoods** achieved. The relevant questions that *ex ante* and *ex post* impact assessment must answer are: What are the changes at the local, national and policy levels that occurred thanks to project implementation? How did they affect diversity and livelihoods?

The scope of implementing a **basket of interventions** with different aims is to provide diverse and relevant "**options**" to the farmers that enhance the value of what they already have. In this regard, it is crucial to identify, develop and offer new ways of cultivating, consuming, processing and marketing the diversity of crops and animal breeds they have as a way of enhancing farmers' choices and well-being by improving their capacities and influencing the institutional environment by providing interventions that enable choice. On-farm conservation projects can be implemented around the world where there are areas of high levels of diversity of global significance, diversified livelihood strategies, intensive use of agro-biodiversity and high cultural diversity. These on-farm conservation projects, if well-designed and successful, should produce a positive cycle of increased diversity and improved well-being, resulting in the maintenance of or increase in crop diversity.

While the final goal is the same for all on-farm conservation projects (to conserve crop diversity and achieve societal benefits through incentives to farmers in the form of direct private benefits that translate into improved livelihoods), the specific interventions of these projects will vary according to the specific outputs and outcomes desired. A diagram (Figure 13, Annex A) outlines how the

decision-making process results in a successful project. The first half of the diagram illustrates the reasoning process for determining the need for an on-farm conservation project. The second half illustrates how the project design, by uniting the overall project goal with the necessary outputs and outcomes, will result in the desired impact.

C. Conclusions

The major findings of the project can be summarized in the form of a set of principles that emerged from the analyses and from discussions at the end-of-project workshop in April that brought together international experts and actors from all the case studies at Bioversity International in Rome. These principles can lend themselves to application in future projects addressing the on-farm conservation of crop diversity and the link to improved livelihoods. Some of these widely applicable principles are described in Table 12.

Table 12: Principles emerging from the analysis of on-farm projects

	Principles	**Description, Caveats and Comments**
1	Assemble a basket of different interventions with different aims	An issue to examine is whether there are interventions that are more successful than others, the reasons for their success and how this can be assessed (what works best). Given that projects provide a basket of interventions and farmers applied several of them, it is not obvious how the effect of specific interventions can be identified and assessed.
2	Carry out an *ex ante* network analysis of partnerships, as well as an *ex post* and compare the shifts with project implementation.	In many of the projects, the achieved outcomes are the result of long-term interactions and investments by different actors working in the area. One has to be careful not to attribute all the outcomes just to the projects themselves. This further complicates the attribution analysis as well as the cost-effectiveness assessment.
	Project interventions should have a clear theory of change.	A narrative describing the intervention, what is expected to be changed with the application (adoption) of the intervention, how that change(s) is/are supposed to have an effect on agro-biodiversity and well-being, what expected observable changes are associated with the intervention (predictions of the interventions on agro-biodiversity and well-being).
	A diagnosis is different from a baseline and the former should be done first and used to inform the latter.	The diagnosis of the situation in the intervention sites should be done before the baseline; one is not a substitute from the other. For a diagnosis one can use secondary data, key informant interviews, and focus group discussions.
	The baseline should incorporate in its design the knowledge generated in the diagnosis, particularly indicators of adoption and success of interventions.	It is essential to have identified the interventions to be applied in a project with their respective theory of change before the baseline is designed. Based on the predictions associated with the interventions, indicators of their application and success should be incorporated into the baseline questionnaire. Usually a baseline should be identified through a survey among a sample of potential participants and non-participants.

A major contribution of this project is the mixed methods approach, which, when applied, captures the complexity of research-based and development-oriented interventions that promote the use and conservation of native crop diversity to improve farmers' well-being. The results, while assessing

ex post the success of six projects in the Andean region, also emphasize the importance of *ex ante* analysis to ensure the achievement of outcomes and thus a sound *ex post* analysis and to draw a number of lessons that can be applicable on a global scale.

The scope of implementing a multi-faceted basket of interventions with different aims is to provide diverse and relevant "options" to farmers that enhance the value of what they already have. In this regard, it is crucial to identify, develop and offer new ways of cultivating, consuming, processing and marketing the diversity of crops and animal breeds they have as a way to enhance farmers' choices and well-being by improving their capacities and influencing the institutional environment by providing interventions that enable choice.

On-farm conservation projects can be implemented around the world where there are areas of high levels of diversity of global significance, diversified livelihood strategies, intensive use of agro-biodiversity and high cultural diversity. These on-farm conservation projects, if well-designed and successful, should produce a positive cycle of increased diversity and improved well-being, resulting in the maintenance of or increase in diversity while simultaneously reducing poverty.

Both the qualitative and the quantitative analyses carried out during the grant demonstrated that on-farm conservation interventions supporting on-farm management of native crop diversity are largely successful and accomplish their objectives in a non-costly manner. ***The results produced by the grant strongly suggest that adoption of the best practices from on-farm interventions has an effect on the relevant biodiversity and that the relevant biodiversity in turn has an impact on livelihoods.***

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Annex A: Figures and Graphs

To accompany the research report on the project "Assessing the Success of On-Farm Conservation Projects in Delivering Conservation and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools"

Figure 1: Impact pathway

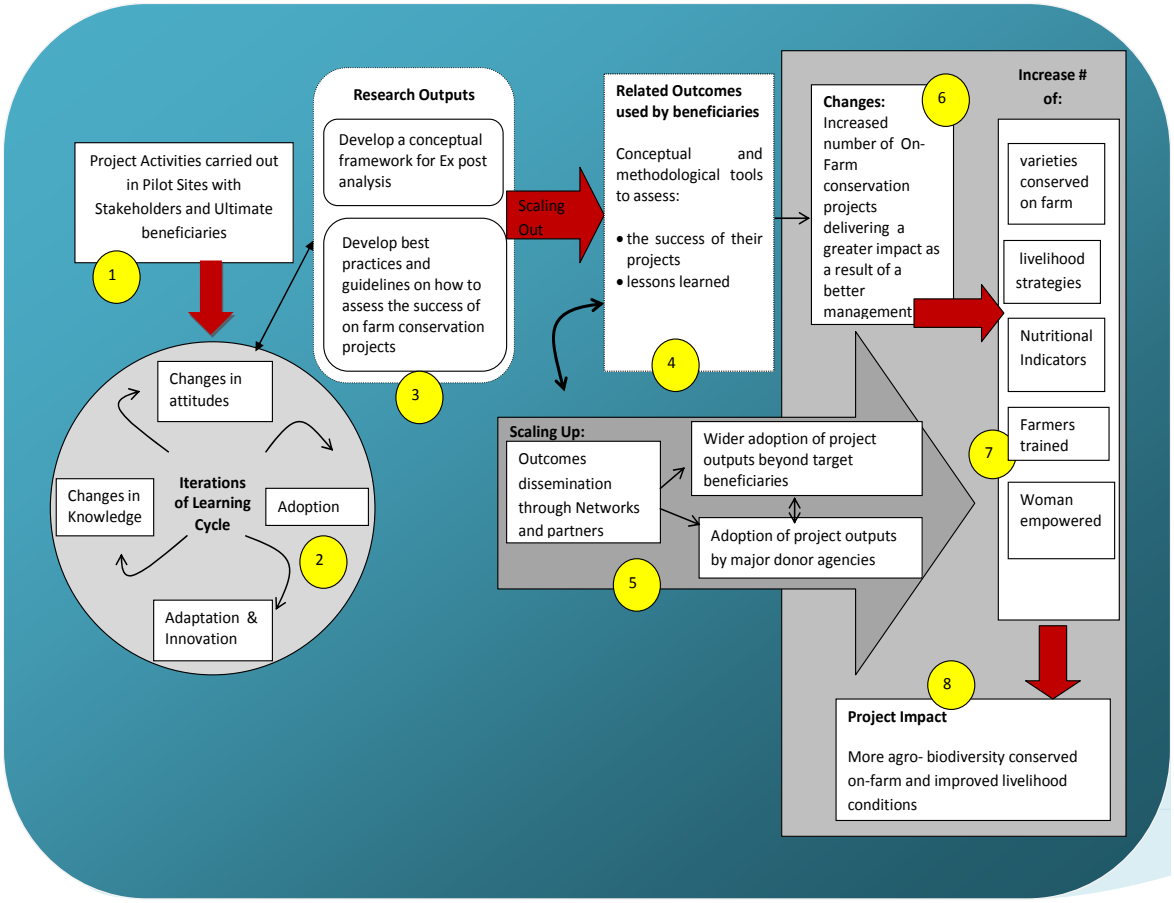


Figure 2: A theory of change

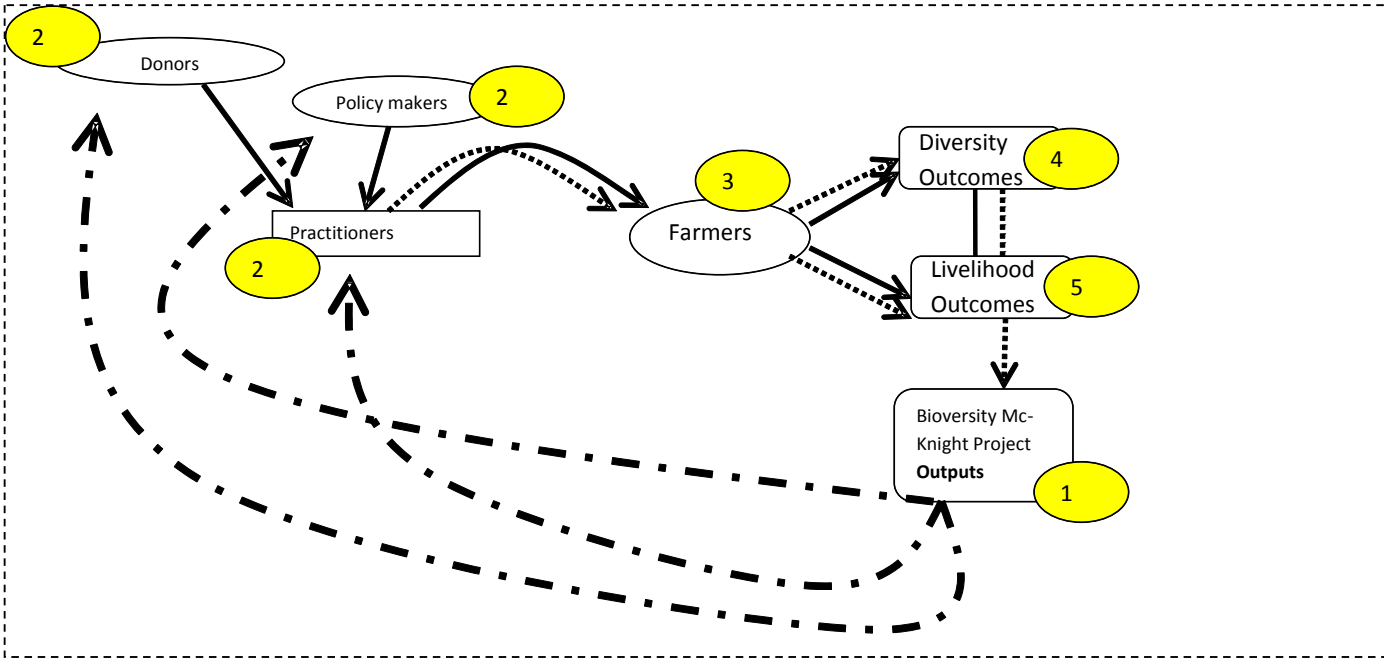


Figure 3.1: Relationship between private livelihood benefits and crop diversity

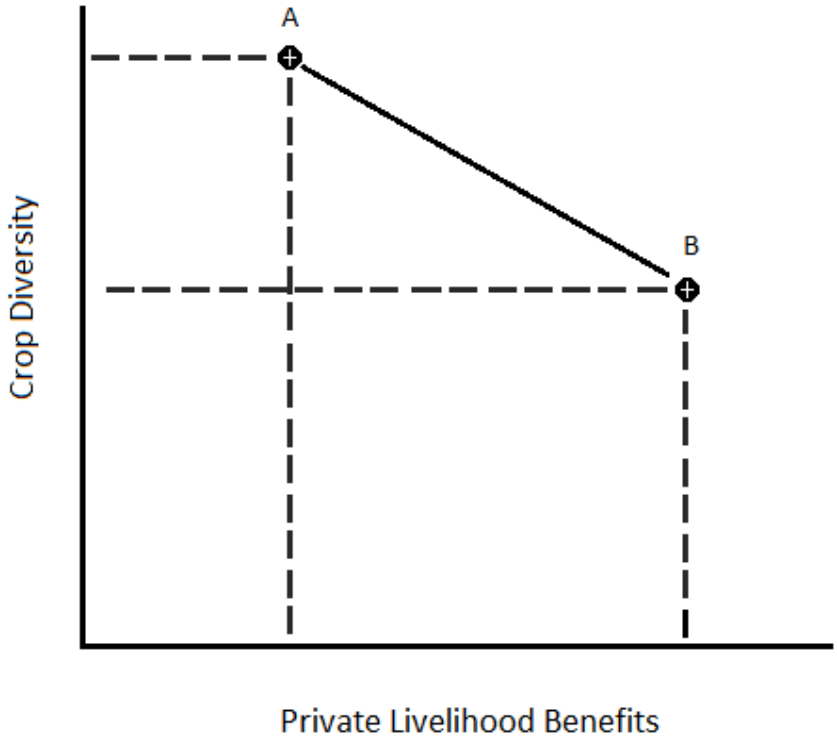


Figure 3.2: Hypothetical relationship between crop diversity and public benefits (evolutionary services)

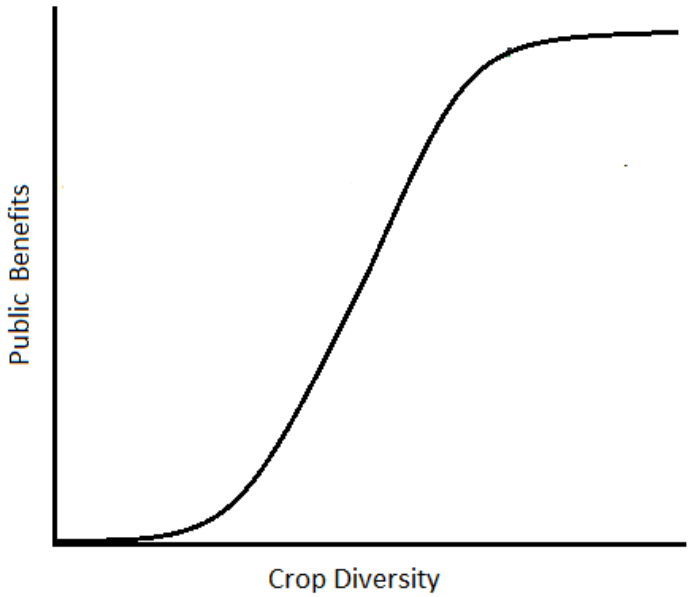


Figure 3.3: Mapping changes in private livelihood benefits unto public benefits through changes in crop diversity

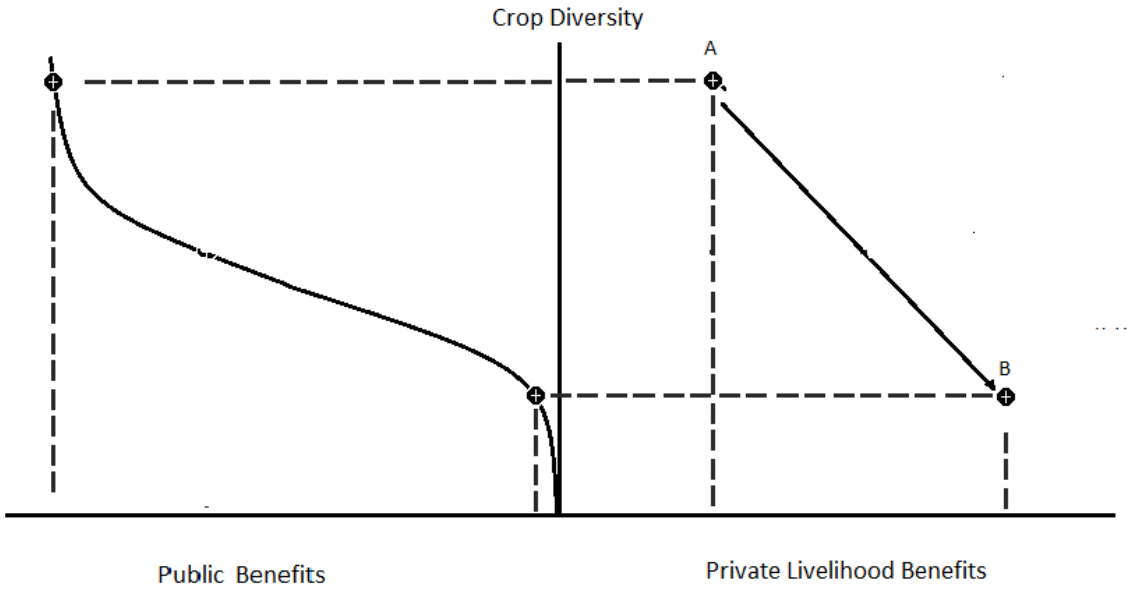


Figure 3.4. Scenarios of change in private and public benefits associated with changes in crop diversity

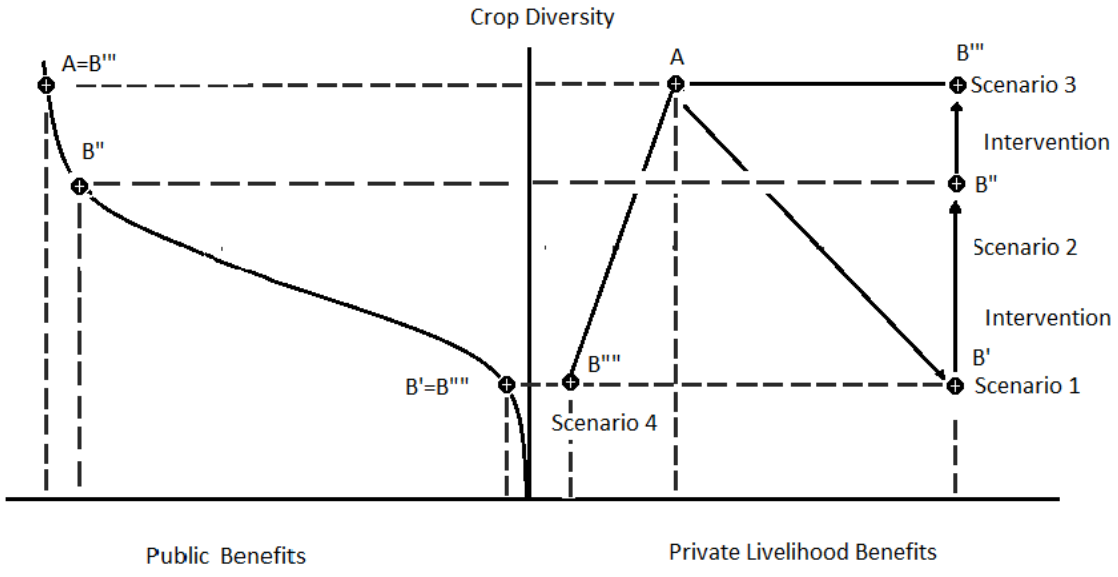


Figure 3.5: Success of on-farm conservation project

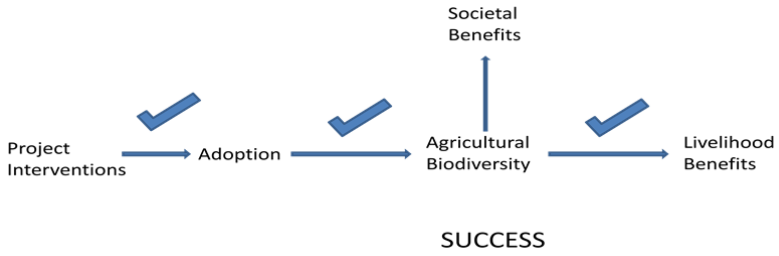


Figure 3.6: Sustainability of on-farm conservation project

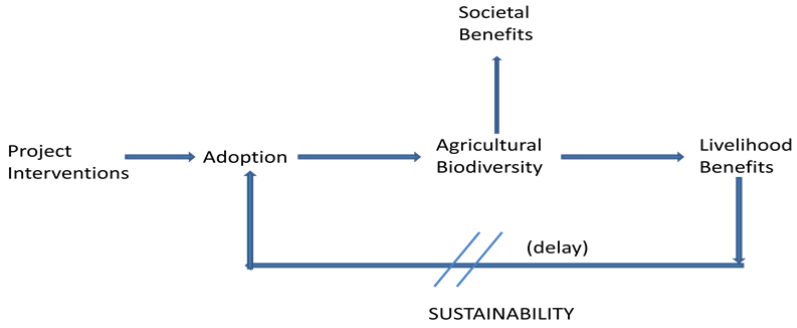


Figure 4: Potential Andean crop richness

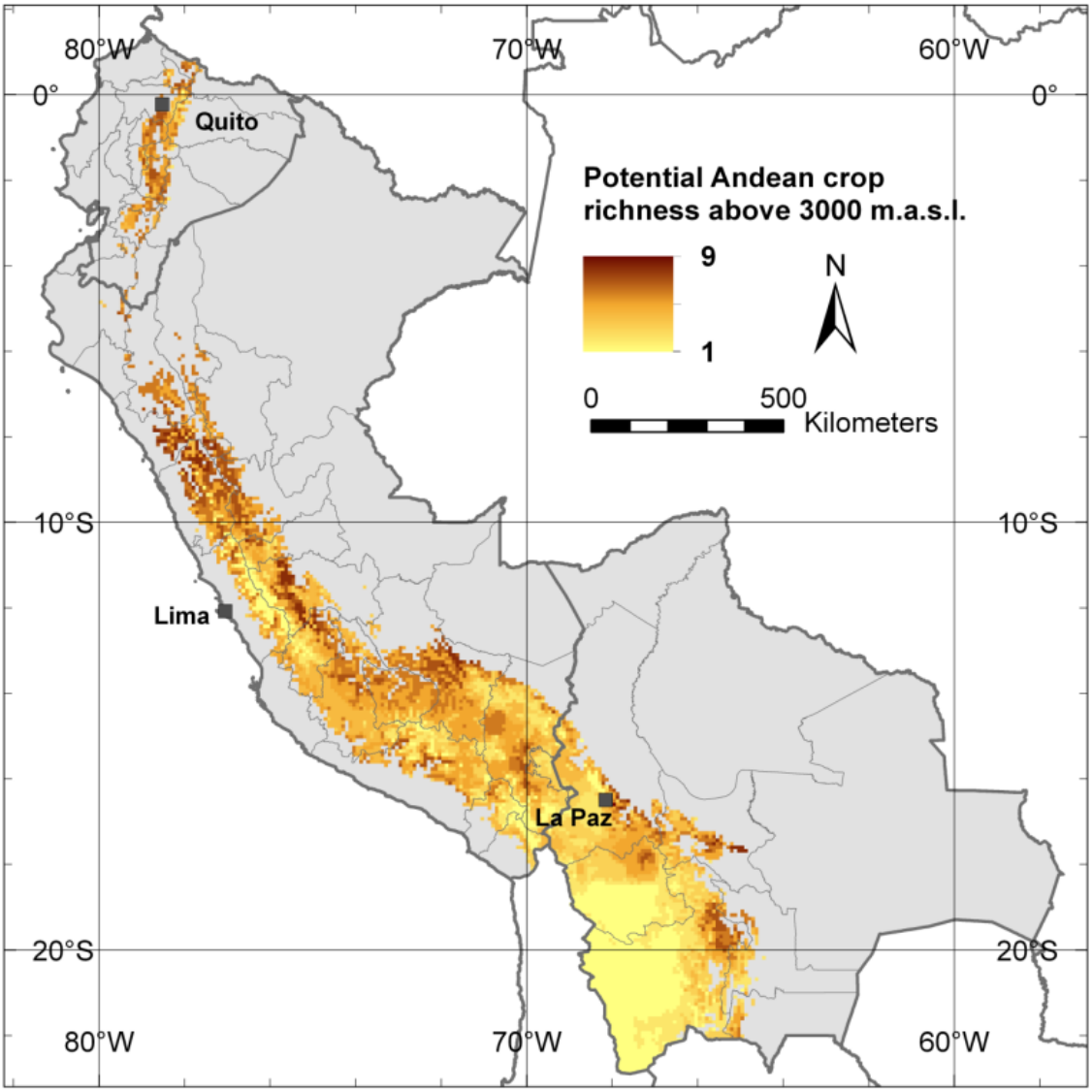


Figure 5: Observed Andean crop richness

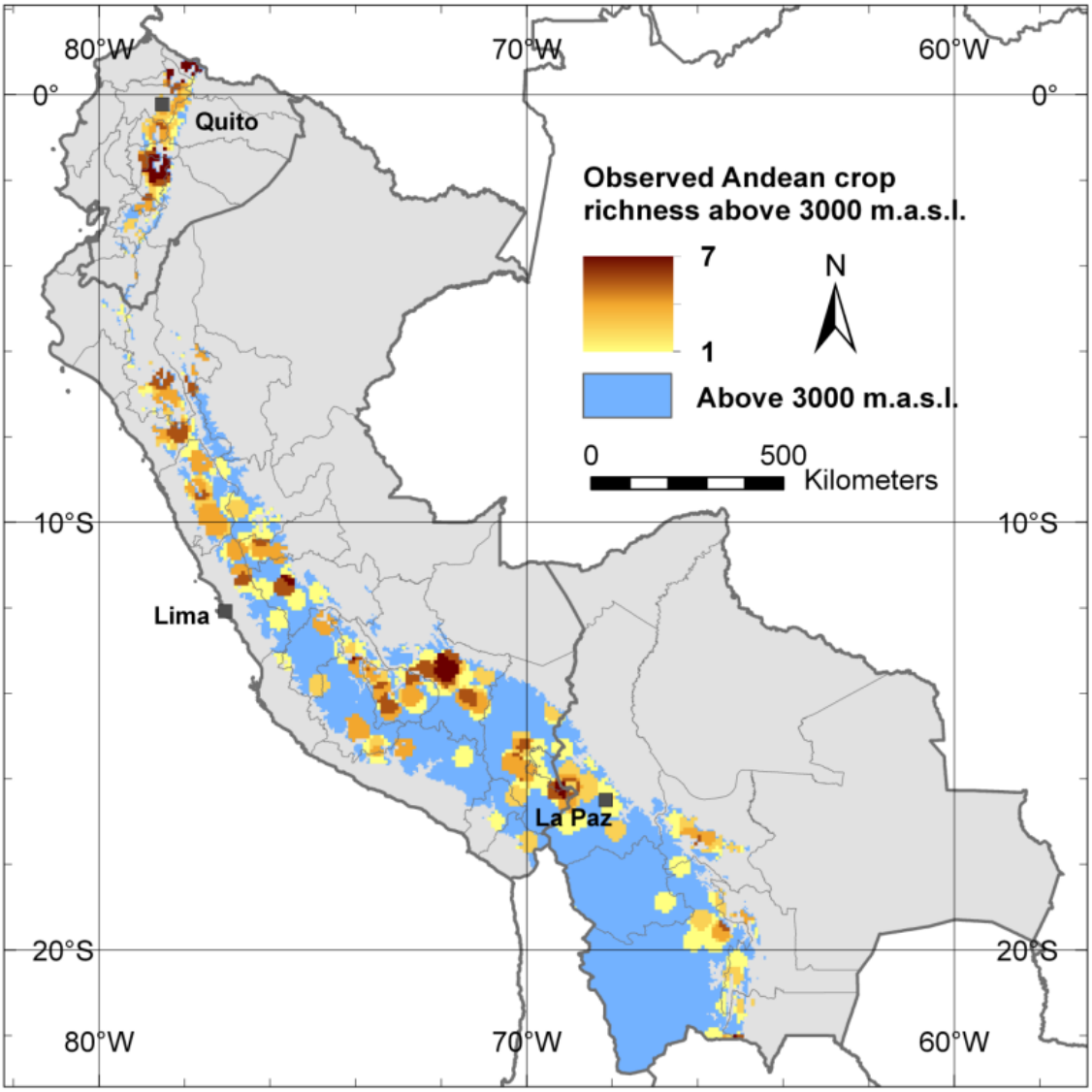


Figure 6: Social Network of the IFAD NUS Project

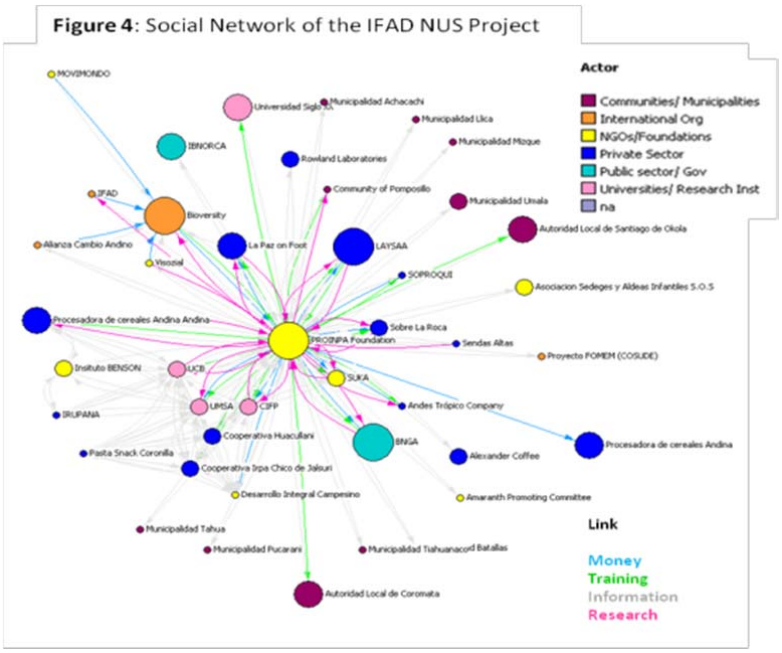


Figure 7: Social Network of the SINARGEAA Project

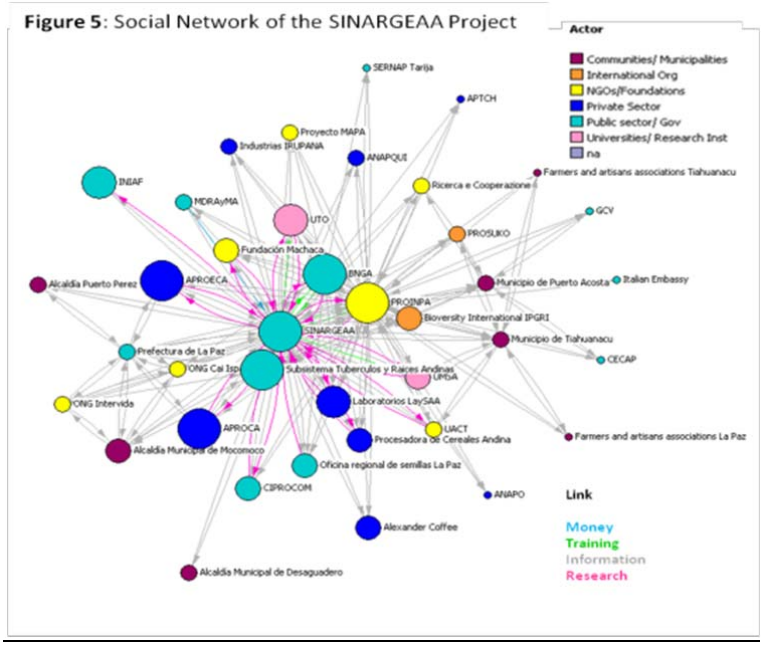


Figure 8: Social Network of the Lupin/Quinoa Project

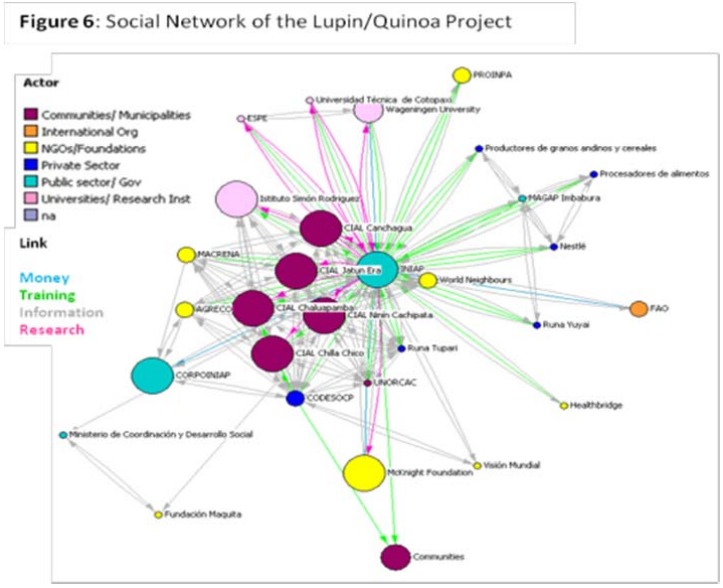


Figure 9: Social Network of the Complementary Conservation Project

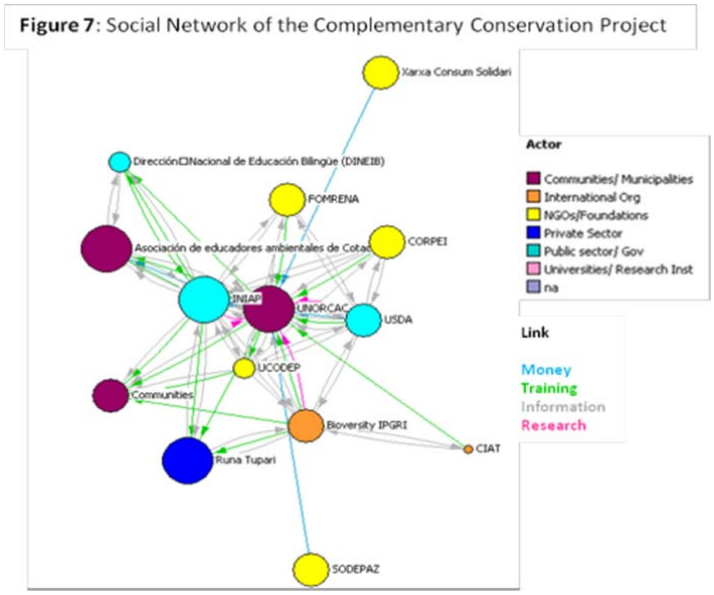


Figure 10: Social Network of the Native Potato Project

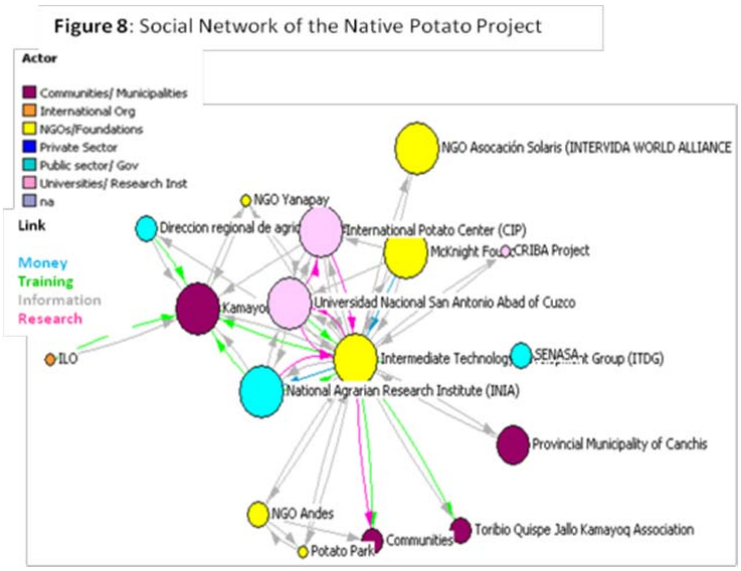


Figure 11: Social Network of the Andean Tubers Project

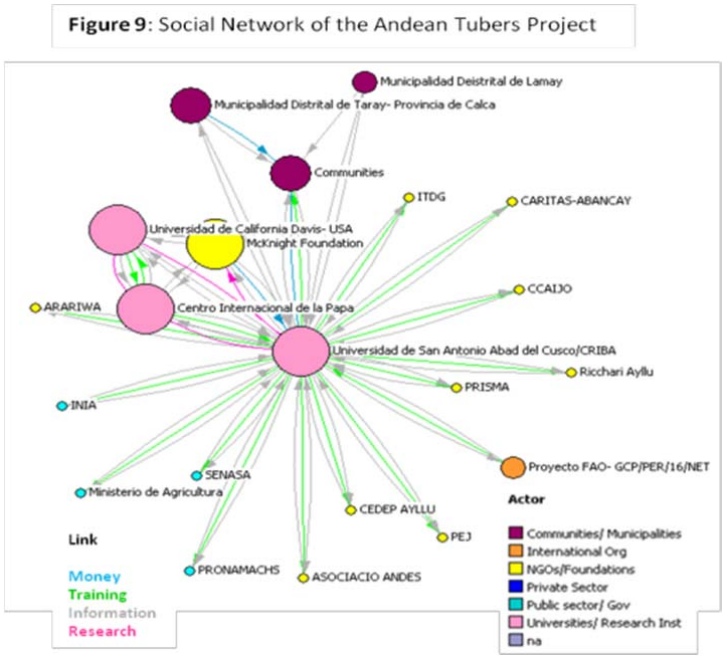
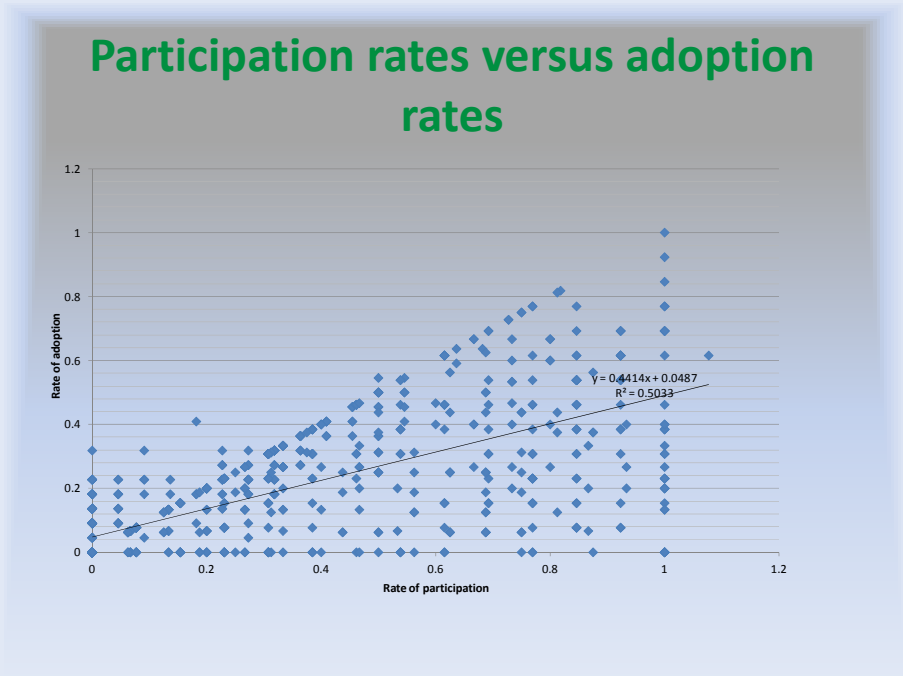
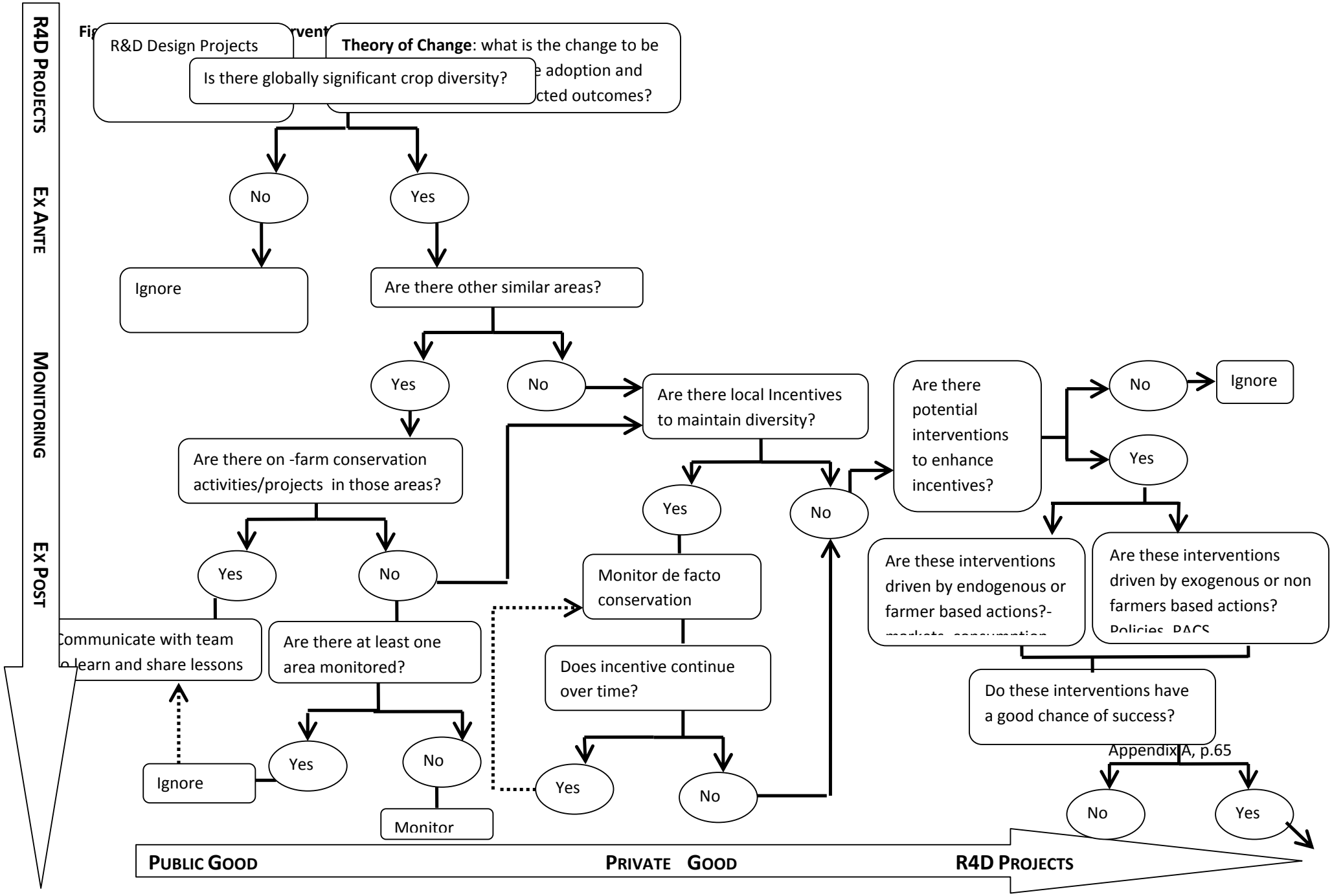
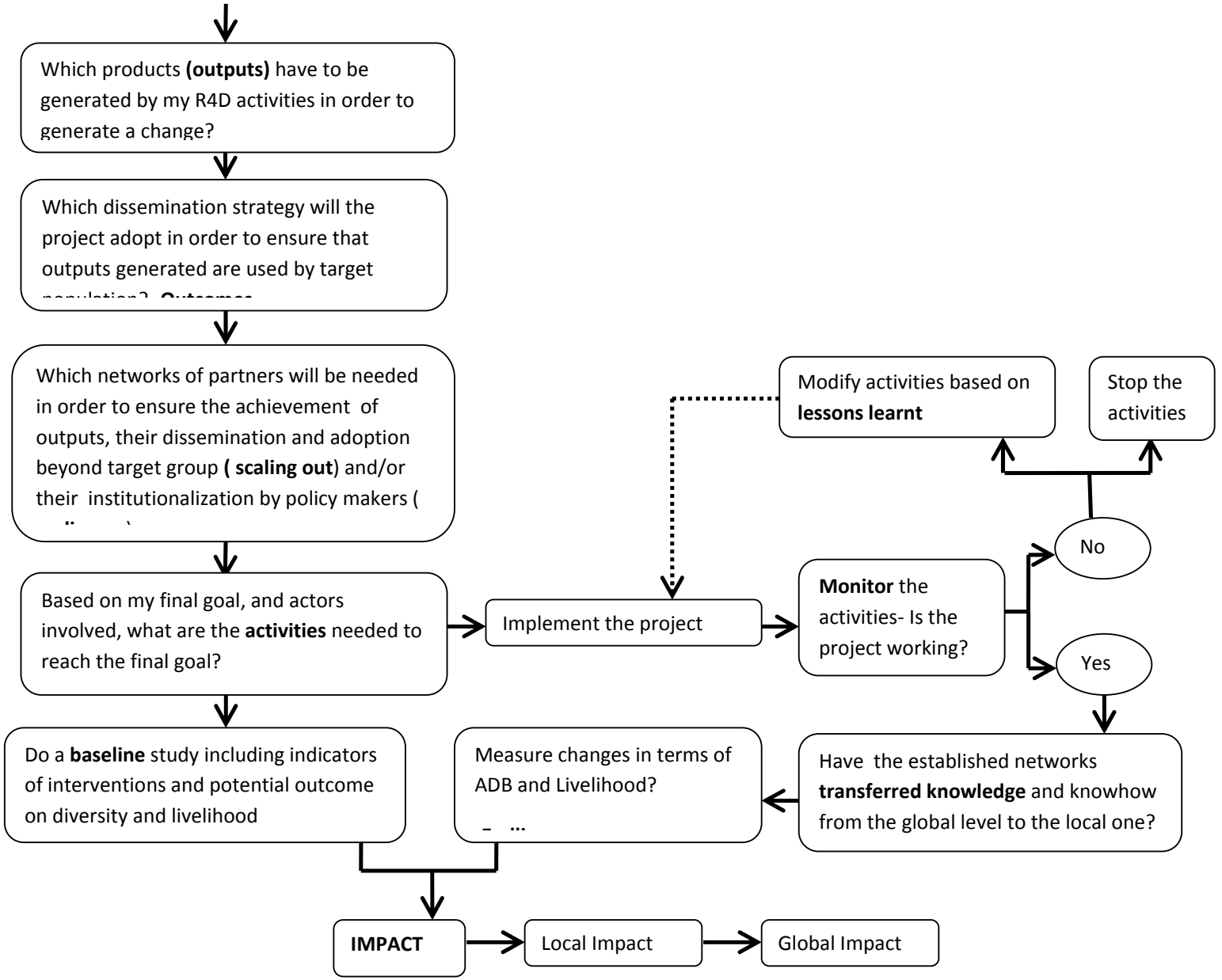


Figure 12: Participation rates versus adoption rates




R4D PROJECTS
EX ANTE
MONITORING
EX POST
R&D Design Projects
Theory of Change: what is the change to be
adoption and
cted outcomes?
Is there globally significant crop diversity?
No
Yes
Ignore
Are there other similar areas?
Yes
No
Are there local Incentives to maintain diversity?
Are there potential interventions to enhance incentives?
No
Ignore
Yes
Are there on -farm conservation activities/projects in those areas?
Yes
No
Yes
No
Are these interventions driven by endogenous or farmer based actions?-
Are these interventions driven by exogenous or non farmers based actions?
Policies, PACS
Monitor de facto conservation
Does incentive continue over time?
Yes
No
Do these interventions have a good chance of success?
Appendix A, p.65
No
Yes
Communicate with team
learn and share lessons
Are there at least one area monitored?
Ignore
Yes
No
Monitor
Yes
No
PUBLIC GOOD
PRIVATE GOOD
R4D PROJECTS


Which products (outputs) have to be generated by my R4D activities in order to generate a change?
Which dissemination strategy will the project adopt in order to ensure that outputs generated are used by target
Which networks of partners will be needed in order to ensure the achievement of outputs, their dissemination and adoption beyond target group (scaling out) and/or their institutionalization by policy makers (
Based on my final goal, and actors involved, what are the activities needed to reach the final goal?
Implement the project
Monitor the activities- Is the project working?
No
Yes
Modify activities based on lessons learnt
Stop the activities
Have the established networks transferred knowledge and knowhow from the global level to the local one?
Measure changes in terms of ADB and Livelihood?
Do a baseline study including indicators of interventions and potential outcome on diversity and livelihood
IMPACT
Local Impact
Global Impact

Assessing the success of on-farm conservation projects in delivering conservation and livelihood outcomes: Identifying best practices and decision support tools

THE McKNIGHT FOUNDATION

Final Technical Report
(March 2010 - November 2012)

Appendix B
Publications Summary & Training and Outreach Summary

Submitted to the McKnight Foundation by Bioversity International
December 2012

McKnight Project Code: 09-1100

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1. Publications Summary

The following publications from the results obtained by the project have been produced:

1. Factsheet 1: A Conceptual Framework for On-Farm Conservation Projects.

2. Hoja de divulgación 1:Un Marco Conceptual para Proyectos de Conservación en Finca.

3. Factsheet 2: Guidelines and Best Practices for On-Farm Conservation Projects: Designing and Evaluating Interventions.

4. Hoja de divulgación 2: Instrucciones y Mejores Prácticas para los Proyectos de Conservación en Finca: Diseñando y Evaluando las Intervenciones.

5. Factsheet 3: Methodologies for Evaluating On-Farm Conservation Projects.

6. Hoja de divulgación 3: Metodologías para la Evaluación de Proyectos de Conservación en Finca.

7. Factsheet 4: Network Analysis for Evaluating On-Farm Conservation Projects.

8. Hoja de divulgación 4: Análisis de Redes para Evaluar Proyectos de Conservación en Fincas.

9. Bellon, M. R., Gotor, E. and Caracciolo, F. Conserving landraces, improving Livelihoods: A framework for assessing the success of on-farm conservation projects (scientific paper submitted to *Economic Botany*).

10. Bellon, M. R., Gotor, E. and Caracciolo, F. Assessing the contribution of on-farm conservation projects of crop biodiversity to resilient agricultural and food systems. Evidence from the High Andes of South America (draft scientific paper under circulation to peers for comments).

2. Training and Outreach Summary

	When	Where	By Whom	To Whom	Topic
Non-degree training for researchers	March 2011	Bolivia	Mauricio Bellon and Elisabetta Gotor	Proinpa researchers	Assessing the impact of Conservation and Livelihood Outcomes, sampling strategies
		Peru		Proinpa researchers	
		Ecuador		Proinpa researchers	
Non-degree training for researchers	June 2011	Vicenza, Italy	Eva Schiffe	Elisabetta Gotor	Network mapping
Non-degree training for Students	Gen-Dec.2011	Rome	Elisabetta Gotor	Genowefa Blundo Canto, PhD candidate	Network mapping, questionnaire development
				Alejandra Trejo, MSc candidate	Dataset cleaning coding and statistical analysis
Workshops for farmers	August 2011	Bolivia	Vivian Polar	Farmers in the project selected communities	Workshop of field work activities and FGD results
		Peru			
		Ecuador	Victor Barrera		
Workshops for Scientists policy makers and donors	April 2012	Rome, Italy	Mauricio Bellon, Elisabetta Gotor	Scientists policy makers and donors	Methods results and implication for assessing the success of on-farm conservation projects

Assessing the success of on-farm conservation projects in delivering conservation and livelihood outcomes: Identifying best practices and decision support tools

THE McKNIGHT FOUNDATION

Final Technical Report
(March 2010 - November 2012)

Appendix G: Full report from literature review

Submitted to the McKnight Foundation by Bioversity International
December 2012

McKnight Project Code: 09-1100

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CONTENTS

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SUMMARY

This literature review focuses on *in situ* – on farm conservation projects in the Andean region with the aim of understanding the activities carried out in the area, the outputs and outcomes gained and how such results are measured in terms of livelihoods and biodiversity. The review includes 26 projects in the Andean regions of Bolivia, Ecuador, and Peru implemented for the *in situ* conservation of native crops, including tubers, roots, grains and legumes. We have selected those projects that had a double objective of preserving agrobiological diversity on farm while improving the livelihoods of farmers.

In scope, this literature review discusses the threats posed to biological diversity, the nature of *in situ* conservation and linkages between diversity and livelihood outcomes, and how these interact with Andean culture and traditional uses. Finally, the discussion considers the indicators of success used by the projects, both in terms of diversity and livelihood, in order to understand the logical framework under which *in situ* conservation is carried out by different actors.

INTRODUCTION

1.1 OVERVIEW

The lack of a systematic assessment of the interaction between diversity conservation and livelihood outcomes has prompted us to draw the present literature review. This work is part of a broader effort to determine to which extent on farm conservation projects deliver livelihood and conservation outcomes and what are the best practices to achieve them.
We will therefore carry out an analysis of on farm conservation projects implemented in the Andean region, addressing four key areas of interest. These are:

1. What projects have taken place, for what crops in which specific locations?

2. For each project, what interventions were implemented?

3. For each project, what were the livelihoods outcomes?

4. For each project, what were the diversity outcomes?

1.2 STRUCTURE

This literature review is divided in four parts. The first part provides a brief introduction to *in situ* – on farm conservation in order to understand the theoretical framework of our analysis. Secondly, we draw the lines of the status of biodiversity in the Andean regions of Bolivia, Ecuador, and Peru, and its connections to the livelihoods of local populations. Thirdly, we review the main components and activities of the selected projects

by targeted crops. Finally, we analyze the indicators used in the projects to measure livelihood and diversity outputs and we draw our conclusions.

BACKGROUND

Rural communities worldwide are key players in the conservation of genetic resources and biological diversity. It is therefore crucial that they assume a relevant role in the management of these resources, on the conservation of which depends their well-being. Agricultural biodiversity in fact offers poor communities in harsh environments options to improve their livelihoods, generate incomes, attain food security and enjoy better nutrition and health (IPGRI, 2005).

In the American continent, populations have used natural resources for their survival for thousands of years, breeding many varieties of plants and animals. Countries such as Bolivia, Ecuador and Peru are among the most important centers of plant domestication in the world and have outlined the basis for modern agriculture in the continent (Tapia, 2007). Indigenous people and peasants in Latin America have in fact contributed to global food resources with an infinite assortment of maize, potatoes, beans, peppers, pumpkins, tomatoes, fruits, and many varieties that can be found in local markets and peasant farms.

However, this richness and diversity is being lost due to changes in consumption patterns, monoculture technologies, marketing opportunities and undiversified diets (UNORCAC, 2008). On the other side, markets have become more homogeneous worldwide, reducing demand to a narrow range of varieties. To this adds genetic erosion or the loss of varieties of seed, tubers, native cultivars and their wild relatives due to factors such as deforestation, desertification, soil erosion, and partly climate change. These determinants have also contributed to the migration of young people from remote areas to populated centers and cities. Besides, the lack of clear policies to benefit farmers, technological dependence and the implementation of an economic model based on the market, has deepened the food problem worldwide.

This situation is aggravating the precarious conditions of indigenous people and communities that live in remote areas facing problems of food security. In the Andean eco-region, four negative trends dominate the agricultural sector (CONDESAN, 1998):

1. The decline of its importance in the economy
2. Strong competition from imported fresh and processed products
3. The reduction in the number of farms and the migration of farmers to cities
4. Increases in the number of poor people, especially in rural areas

However, these trends have been accompanied by other positive aspects such as the emphasis on non-traditional agricultural exports, interest in agribusiness and agricultural development, and the demand for natural, organic and exotic products by richer consumers. These trends provide new opportunities for Andean producers to break the cycle of poverty while helping the conservation and protection of local genetic variability.

Latin America is a region of extreme inequality aggravated by a political and institutional framework which excludes the poor and vulnerable from decision making processes (Devaux et al., 2005). Remote communities are deprived of the opportunity to access and contribute to information systems, and people employed in the agricultural sector are usually the poorest. Bolivia, Ecuador and Peru in particular suffer from extremely high degrees of inequality, with poor people concentrated in isolated rural areas of the Andes, depending for their survival on insufficient land holdings and fragile ecosystems (IFAD, 2010). In Bolivia, some 20% of the population (total: 8 million) lives under the poverty line, in Ecuador 35% (total population: 13.5 million), and in Peru 44.5% (total population: 29 million). The majority of poor people in these countries are peasants, mostly of indigenous origin. Rural poverty in Bolivia is concentrated in the highlands and valleys, where it affects more than 2 million people, of which 1.6 live in extreme poverty. Most of the poor are indigenous people. The

situation is similar in Ecuador, where 87% of indigenous people and Afro-Ecuadorians are poor, especially in rural areas of the plateau. In Peru, the poorest of the poor are indigenous people living in remote areas in the southern highlands, where about 73% of the Quechua and Aymara communities – more than 5 million people - live below the poverty line.

The reasons for this must be sought in the historical social exclusion of Andean and Amazonian indigenous people and their fight for self-determination, control over their territories and over natural, intellectual, and communal resources (Tirso, 2000). Moreover, indigenous populations are important for the conservation of biological diversity as it is highly correlated to their cultural diversity (Brush, 2000). Peru for instance, one of the countries with the highest levels of agro-biological diversity worldwide, has 51 ethnic groups (around 30% of the population) who practice different *in situ* conservation strategies. In the Andes, Quechua and Aymara originated people are the primary nurturers of agro-biodiversity. The Andean region therefore offers a rich basin of opportunities for the promotion of *in situ* conservation of crop genetic resources.

IN SITU CONSERVATION

The conservation and use of biological diversity are crucial for an environmentally sustainable and socially equitable development (Secretariat of the Convention on Biological Diversity. 2002). The strategies to protect the functions and diversity of ecosystems have often involved the creation of natural reserves or protected areas and the support to genetic richness at a national level. Besides the creation of protected areas, a common strategy is *ex situ* conservation or the conservation of components of biological diversity outside their natural habitats, for instance in gene-banks and germ-plasm banks. However, the worldwide concern on the loss of biodiversity has led to new strategies involving a more direct engagement of those who use and maintain this biodiversity everyday as part of their livelihoods strategies (e.g. farmers, breeders, fishers, lumberjacks). This renewed interest in the link between traditional practices of indigenous and rural communities, who have domesticated and selected agricultural variety through the ages, has led to the implementation of *in situ* conservation practices. According to the Convention on Biological Diversity, in-situ conservation means 'the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties'.

The long-term goal of *in situ* conservation is to protect, manage and monitor selected species' populations in their habitats so that the natural evolutionary processes can be maintained, generating new variation in the gene pool that allows the species to adapt to changes in environmental conditions such as global warming, changed rainfall patterns, or acid rain (Heywood and Dulloo, 2005). In practice, *in situ* conservation means leaving and protecting the seed inside the specific region, area and place where its variety has originated and developed rather than in a gene bank or separate conservation center. Bellon (1997) defines it as 'the continuous cultivation and management of a diverse set of populations by farmers in the agro-ecosystems where a crop has evolved'.

The potential of *in situ* conservation to conserve the process of crops' adaptation to their environments, and maintain diversity of ecosystems, species and genes, is linked to its potential for the empowerment of farmers and their access to local genetic resources (Wood and Lenne, 1997). *In situ* conservation concerns in fact entire agro-ecosystems from cultivated crops, forages and agro-forestry species, to their wild relatives in forests and protected areas. These inter-linkages shape *in situ* conservation projects, which achieve different objectives including:

- The conservation of evolution and adaptation processes of crops to their environments
- The conservation of ecosystem, species, or gene diversity
- The integration of farmers into a national plant genetic resources system
- The sustainable conservation of functional ecosystem services
- The improvement of rural livelihoods through economic and social development

- The improvement of farmers' access to and control over crop genetic resources

The benefits of *in situ* conservation thus belong to the socio-economic, ecologic and genetic sphere (Jarvis et al., 2000).

However, the definition of *in situ* conservation has been often used to describe the creation of protected areas or habitats, paying less attention to the actual conservation of species *in situ*. Heywood and Dulloo (2005) have defined the range of interventions that follow under the definition of *in situ* management:

1. Conservation of natural or semi-natural ecosystems in various types of protected area: conservation of the area and, non-specifically, of the biodiversity of the area.
2. Conservation of agricultural biodiversity: preservation of diversity within and among populations of species used directly in agriculture in the habitats where it developed and grows. This includes food crops, forages, and agro-forestry species and their wild relatives, but also conservation of landraces or local crop varieties in farmers' field (on-farm conservation).
3. Conservation and maintenance of selected/target individual species: conservation and management plans in the species' natural habitat or ecosystem (genetic conservation).
4. Recovery programs for nationally or sub-nationally threatened, rare or endangered wild species: a case of *in situ* conservation of target species they may require recovery of the habitats.
5. Restoration, recovery or rehabilitation of habitats: species recovery programs may require not only management and reinforcement of populations but also rehabilitation or restoration of the habitats in which the often fragmented populations occur.

Therefore, *in situ* conservation requires a focus on the biodiversity, the dynamics and the conservation of all the components of an ecosystem.

Brush (2000) defines two types of *in situ* conservation. The first is the conservation of crop genetic resources in areas where farmers maintain diversity on their farms through their everyday practices, or *farmer-driven* conservation. The second type concerns incentivizing farmers to *in situ* conservation through Research & Development (R&D) strategies, or *externally driven* conservation.

Farmer driven conservation is the management of agrobiodiversity through the cultivation of specific crop populations. The genetic diversity that farmers use and pass on to future generations is therefore the result of a constant process of experimentation, evaluation and selection of existing and new varieties. This selection, according to Bellon (1997) is done on two levels: the farmers choose the varieties to be maintained; and then, for each variety, they choose the seed stock to replant the next season. This selection process is dynamic and affected by supply of new or existing populations from other farmers, villages, regions or even countries. To manage this diversity farmers apply a four components' strategy:

1. **Seed flows:** the exchange of traditional and modern germ-plasm within villages, regions, and within and among countries. Thanks to increasing exchange, migration and trade, the germ-plasm of modern varieties originated in different countries, increasing the diversity of populations.
2. **Variety selection:** farmers select from the previous agricultural cycle, or through exchange and purchase, the varieties they want to keep and discard in a growing season and thus determine the diversity present in their fields. This selection process depends on how the crop populations or varieties meet the farmers' needs (agro-ecological, efficiency of crops' use, technological etc) thus reflecting their objectives, their work conditions, and their socioeconomic and cultural characteristics. Variety selection is also the result of an experimentation and evaluation process that involves communication and exchange of information between farmers, developing new knowledge.
3. **Variety adaptation:** crop population become increasingly adapted because the farmers select them and maintain them for the characteristics and conditions that make them superior to the varieties discarded. The specialization of varieties thus depends on how strong the selection process has been.

4. **Seed selection and storage:** apart from selecting varieties, farmers must also select the seeds, a process that depends on the type of pollination and propagation of the crop. Seed selection for the production of new strains is also an important source of diversity.

It follows that the main beneficiaries of *in situ* conservation are local farmers and communities who directly use diversity, and whose culture and traditions have maintained and contributed to diversification. For centuries farmers have selected seeds for various characteristics, breeding plants and saving seed for replanting, but such practices go beyond pure conservation by improving and developing plant genetic resources. For rural communities to maintain this fundamental role, the formal sector must recognize the importance of their knowledge and experience, allowing them to evaluate and select new technologies, and enhancing partnerships to strengthen targeted cultivars. Moreover, as most of agricultural diversity is in the hands of small and marginalized farmers or indigenous communities of ancient and traditional cultures, who use most of their production for self consumption, the protection and improvement of traditional production systems, linking it to the cultural heritage that sustains them, has the potential to become one of the best strategies for conserving the diversity of crop species.

BIODIVERSITY IN THE ANDES

Figure 1: www.cepf.net

The Tropical Andes span 1,542,644 km2, from western Venezuela to northern Chile and Argentina, including large portions of Colombia, Ecuador, Peru, and Bolivia. They are considered the most diverse region in the world, containing a sixth of all plant life in less than 1 percent of the world's land area (Conservation International, 2007). This region faces several threats including mining, timber extraction, oil exploration, and narcotics plantations, which are all expanding following the continual growth of the population and of many surrounding large cities. The cloud forests face increased pressure from hydroelectric dams, and invasive species like the American bullfrog and grasses for cattle grazing are threatening the ecosystem.

The Andes mountain range is characterized by high peaks, deep canyons, steep slopes, and isolated valleys that have favored the evolution of an amazing diversity of microhabitats and species. At different altitudes different types of vegetation are found. Tropical wet and moist forests occur between 500 and 1,500 meters. Various types of cloud forests extend from 800 to 3,500 meters, including the montane cloud forests (yungas, ceja de selva, or ceja de la montaña) that cover more than 500,000 km in Peru and Bolivia and are among the richest and most diverse on Earth. At higher altitudes (3,000-4,800 meters), grassland and scrubland systems reach up to the snow line. The Andes holds in fact 84 out of the 103 ecosystems identified in the world, and it is considered one of the eight principal centers of crop genetic diversity in the world (ISNAR 1987). These include the *páramo* in the humid northern Andes, with thick and dark mountain vegetation growing on highly absorbent mosses, cushion plants and other forms of vegetation adapted to the cold, and the drier, cold, southern Tropical Andes of the *puna*, characterized by sub-alpine and

steppe-like grass species surrounded by herbs, lichens, mosses and ferns. Some dry forests, woodlands, cactus stands, thorn scrub, and *matorral* complete this set of ecosystems (Conservation International, 2009).

Many crops have originated from the Andes, including potatoes and tomatoes, and Andean people have domesticated tens of different crop species, including roots, grains, legumes and fruits for thousands of years, resulting in a rich diversity of native cultivars adapted to the unique ecological conditions of the region. Climate variability (within years, between years, decades and centuries) has had an effect on the biodiversity of species and the use of individual plots in different altitudinal and physiographic areas. For instance, the biodiversity of Andean roots and tubers is focused in some micro-centres which are probably the product of a long process of evolution of wild plants, early domestic and prehispanic agriculture. In these areas, genetic erosion is due to:

- Low market demand
- Low profitability
- Limited availability of arable land
- Growing preference for other species
- Abiotic and biotic problems
- Low availability of quality seed

Moreover, the Andean highlands are home to some of the poorest rural households in South America. Native varieties and local knowledge for their cultivation and use are unique resources possessed by farmers in these areas. Most of the poor practice in fact subsistence agriculture in small farms (GTZ Sustainet, 2008), facing many problems:

- Pro-consumer and pro-urban policy
- Feeble institutions for the promotion of agriculture
- Lack of legal security of land titles
- Lack of adequate infrastructure
- Poor marketing channels
- Unequal trade relations worldwide
- Prevalence of smallholdings
- Low capitalization of the production units and low productivity
- Lack of policies that address the weak organization and business management of farmers
- Low agricultural competitiveness and profitability
- Falling real agricultural prices and limited access to markets
- Inadequate management and use of natural resources
- Soil degradation, deforestation and pollution

Currently, *in situ* conservation in the Andes is mainly carried out by marginal and indigenous communities, with small and scattered efforts by other actors. The capacity of farmers and organizations needs thus to be strengthened to increase the conservation of farm genetic resources. Moreover, the agricultural sector in the region is divided in commercial and peasant. Commercial agriculture is heavily dependent on new genetic material, including hybrid seeds, high levels of agrochemical inputs and mechanization (Pomareda, 2010). Peasant agriculture on the other side strongly depends on local seeds. The Andean culture is characterized by a strong culture of the seed, meaning that the native seeds are embedded in the diversity of indigenous agriculture as opposed to commercial seed mainly of western origin (Tirso, 2000). Rural areas in the region are also rich in undomesticated biodiversity, which is often exploited on a small scale by native communities for food and medical purposes. However, without proper recognition of communal rights and in absence of a regulatory framework the exploitation of these resources is one of the greatest threats to biodiversity conservation in the Andes.

IN SITU CONSERVATION PROJECTS IN THE ANDEAN REGIONS OF BOLIVIA, ECUADOR AND PERU

According to the Andean worldview (Rea, 1995), *in situ* conservation represents the caring on farm breeding of plants in their own environment, providing a natural evolution, with the goal of using crops in multiple ways that allow a healthy life and diet for current and future generations, with great respect and knowledge of crops' wild relatives (INIEA, 2009). *In situ* conservation has been carried out virtually since the beginning of the domestication of plants. For farmers all varieties are useful since they suit different purposes and represent an insurance against climatic risk, in addition to the variety of flavors and a certain social prestige for the possession of a great variety of plants. Therefore, *in situ* conservation is practiced by a great number of Andean farmers, especially small farmers in remote areas. In the whole Andean region the peasant is the crucial unity for the conservation and use of genetic resources, interacting with socio-economic and ecological environment, and creating complex relationships that can only be fully understood through detailed studies and long term approaches.

Rea maintains that the concept of *in situ* is connected to the evolution of Andean people, and the native art of manipulating biodiversity, linked to the family and the creation of life, which represents a live, dynamic, evolving characteristic of Andean farms, families and communities (Figure 2).

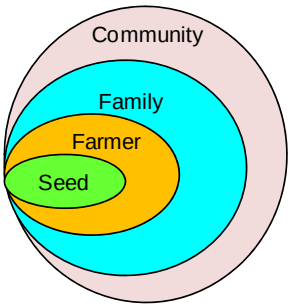


Figure 2:
Ancestral conservation system in the Andes

Also, the social and communal management of the soil in many high Andean communities is the main tool of conservation of Andean genetic resources. Many decisions, particularly in the highlands, are taken at community level rather than in the families and regard which crops are to be cultivated, if and how they will be associated, how they will be distributed and even the number of years of soil rest. This strong connection with Andean identity makes it difficult to measure outcomes on the basis of scientific methods and requires an analysis of the cultural world surrounding the management of biodiversity in the area.

Traditional Andean agriculture is guided by indigenous technical knowledge, which has developed production and conservation practices such as climate prediction by astronomical and biological indicators, use of various crop associations, mixtures and rotations, different preparation and management of soil in dry or wet years, complementary techniques of crop and livestock management, and varied and effective community organization (Agualtiplano, 2003). However, production processes lack support in technical assistance, credit and marketing to make them more productive and improve product quality, while access to services are limited and prices inadequate for producers. Given the lack of bargaining power and the lack of organization of producers in the markets, intermediaries and processing plants do not pay more for a quality product. To compete in the market they seek to minimize their costs to the detriment of producers. These dynamics also occur with those who produce for export (such as with organic quinoa), because of unfavorable partnership conditions with other businesses (Agualtiplano, 2003). The situation discourages indigenous communities to improve quality, creating a vicious circle that constrains the opportunities of income improvement. Also the availability of specialized human capital is limited and the conditions for developing technological innovations necessary to improve quality in various phases of the cycle (cultivation, processing, marketing, etc.) must be strengthened to comply with volume and quality demands.

The projects

In order to understand the overall context of conservation activities in the Andes we have carried out an extensive desk and internet-based research of *in situ* projects in the region. Although Bolivia, Ecuador and Peru are characterized by the presence of thousands of agricultural institutions working in different areas from livestock and plants conservation to technology promotion, the interventions specifically aimed at on farm conservation are few, partly because of the relative newness of such practices and partly due to scarce investment.

To draw our review, we have selected and compared 26 *in situ* projects in the selected Andean area in order to understand what kind of interventions have taken place, for what crops and at what specific locations. This general review is the first step in the direction of evaluating success stories and defining best practices of *in situ* conservation that deliver livelihood and diversity outcomes. Detailed information on the expected results and outputs generated by the projects studied is provided in Annex I (Tables 1-2).

We have analyzed projects working in the conservation of the diversity of Andean roots and tubers (10 projects), grains (7 projects), and legumes (2 projects); local neglected and underutilized species (2 projects); native cultivars and their wild relatives (1 project); forest management and forest products (2 projects); seed systems of Andean crops (1 project); and finally one project aimed at removing obstacles to direct private sector participation in the conservation *in situ*.

Sources of funding for biodiversity conservation in the Andean region

Some international actors are particularly involved in supporting and providing funds for conservation initiatives in the Andes of Bolivia, Ecuador, and Peru. Among them, the "Small Grants Programme for Biodiversity", funded by the Global Environment Facility (GEF) and administered by UNDP, funds small projects (with a budget averagely ranging from 20.000 to 40.000 dollars), often co-financing with other agencies. The SDC (Suisse Agency for Development and Cooperation) funds many large projects in the Andean region, providing consistent support around 1.000.000 dollars or more. IFAD (International Fund for Agricultural Development) has also financed a global scale project with a regional focus in the Andean region of Bolivia and Peru. Finally, the McKnight Foundation and other foundations finance several small-medium projects generally aimed at biodiversity conservation and improvement of food security and livelihoods.

In the following sections we will analyze the geographical and biodiversity framework in which selected projects were developed, their objectives and the activities carried out.

GEOGRAPHIC DISTRIBUTION OF INTERVENTIONS

Hereafter we provide an overview of the status of diversity conservation in the three countries under study, followed by a summary description of the diversity and socio-economic status of the regions where the selected projects were implemented, in order to better understand the specific context in which they took place. Overall, the geographical distribution of projects is as follows

- Bolivia (Departments): La Paz – 5 projects; Potosí – 4 projects; Cochabamba – 3 projects; Chuquisaca – 1 project; Oruro – 1 project; and 1 national project
- Ecuador (Provinces): Chimborazo – 3 projects; Pichincha – 2 projects; Cotopaxi – 2 projects; Carchi and Imbabura – 2 projects; Cañar and Azuay – 1 project; Pastaza – 1 project; Morona Santiago – 1 project;
- Peru (Regions): Cusco – 3 projects; Puno- 3 projects; Cajamarca – 1 project; Huancavelica – 1 project ; and 1 national project

BOLIVIA

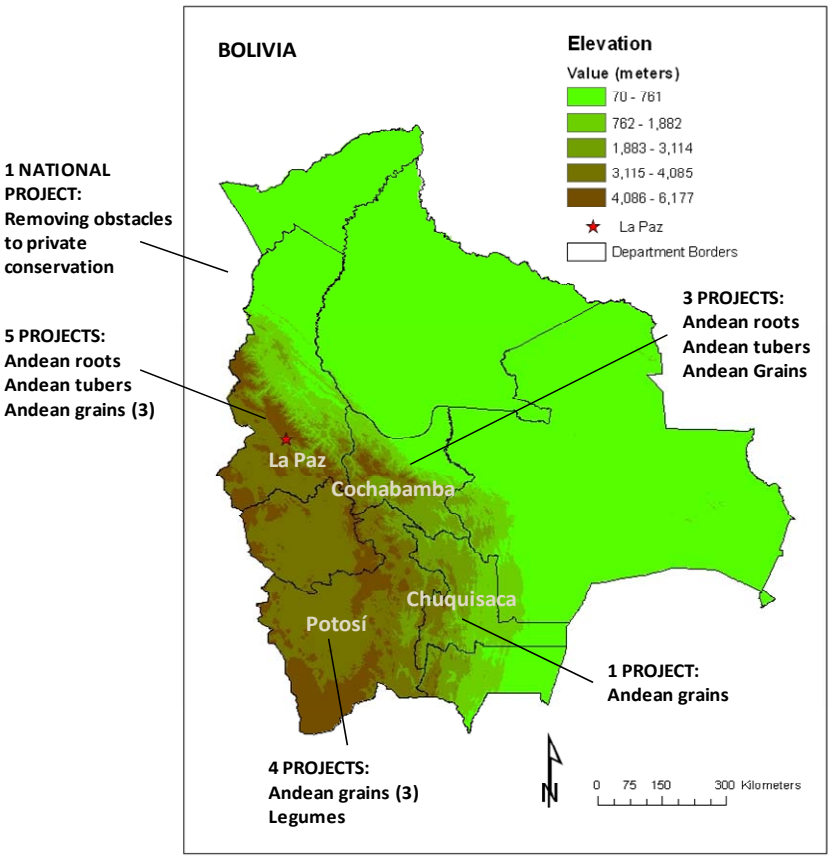


Figure 3: Distribution of projects by region and crops – Bolivia

Located in the Neotropical zone, Bolivia is characterized by an extraordinary biological diversity. Its uniqueness is in the great diversity of ecosystems: from tropical forests (covering about 49% of the total surface area); high Andean grassland plains (30%), savannas (20%) and wetlands (1%). The ecosystems with highest species diversity in Bolivia are the Yungas and Sub-Andean Amazonian Forests (*Bosques Amazónicos Subandinos*), situated on the northeastern slopes of the Andes. There are 22 Protected Areas (PAs) from Manuripi through Madidi, Apolobamba, Pilón Lajas, Cotapata, Isiboro Sécure, Carrasco, and Amboró. The Amazonian lowlands of Pando, Beni, northern La Paz, northern Cochabamba, and northern Santa Cruz also have high levels of species diversity (Araujo et al., 2005). Bolivia is also rich in endemic species (species with relatively limited geographic distribution): it has at least 100 endemic species of vertebrates, and about 25 percent of the vascular plants found in the country (4,000-5,000 species) could be endemic. As for genetic diversity, about 50 species of native domesticated plants are known in Bolivia, and around 3,000 medicinal species are used locally and regionally (Ministerio de Desarrollo Sostenible y Planificación, 2003). Domesticated native animals, including unique Andean camelids such as alpacas and llamas are economically important.

Key threats to Bolivia's biodiversity and tropical forests in order of gravity are (USAID, 2008):

- Loss, conversion, and degradation of forests and other natural habitats: increasing destruction of habitats caused primarily by deforestation for the conversion of land to agriculture and cattle ranching, commercial logging, fires, human settlement in rural areas, and coca production
- Pollution of aquatic ecosystems: mining wastes especially in the Cordillera and Sub-Andean region; misuse of agrochemicals such as pesticides and fertilizers; coca processing which discharges acids, diesel, and other chemicals; and municipal and industrial solid and liquid wastes
- Overharvesting of selected species: illegal harvesting and unsustainable management plans
- Exotic invasive species: some European and other external species imported to Bolivia are threatening native species in the competition for resources or affecting native vegetation not adapted to their herbivory and feed characteristics.

In 1993, Bolivia embraced the concept of sustainable development brought about by the World Summit[1] that integrates economic, social and environmental issues adding social participation in decision-making aspects, efficient management and transparent institutions (UNDP, 2005). Since then, sustainable development attempts were promoted through the General Plan for Economic and Social Development (PGDES) "Change for All" (1994); the "Bolivia XXI, País Socialmente Solidario" (1998), several local Development Plans, The Dialogue Act (2001) and more recently the Productive Dialogue Act (2004).

COCHABAMBA

- *Proyecto Integral Candelaria*
- *Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi*
- *Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA*

Located in the inter-Andean valleys ecoregion, Cochabamba has a high level of species diversity. However, the region suffers of a grave loss of biodiversity due to the rapid urbanization of the region at the expense of natural forest vegetation and wildlife; changes in the habitats of crops' wild relatives due to deforestation through fire; habitat disruption due to human presence, traffic, noise, roads, tourism, that leads to the disappearance of wildlife. In the central area of Cochabamba department, the Chapare province, presents a great variety of plant and animal species due to its sub-tropical and tropical climates, with potato cultivation contributing to 60% of family income. The area is characterized by three zones (the flat pampa, the hillside and the hilltop) which differ in altitude, climate, vegetation and cultivars. Agronomic management of crops and varieties and their uses also differs in each zone and represents the basis of conservation strategies of natural resources in the area. Despite strong links with the market, which demands only a small number of commercial varieties, this micro-center has managed to maintain its diversity of Andean tubers. The population of Candelaria is made up of small farmers and smallholders (9 ha), a third of which are poor. Almost the entire population is engaged in agricultural production with two predominant forms of land tenure: family property in the valley bottoms and low hills, and communal property, in the highlands. The commercilaization of products takes place through rural fairs in Sacaba, Quillacollo, Colomi and El Puente, and through fairs in Charahuayto and Pocanche.

LA PAZ

- *Proyecto Integral Altiplano*
- *Promoción de Cultivos Andinos: "Desarrollo de Agroindustrias y Mercados para la Arracacha"*
- *Conservación complementaria ex situ - in situ de especies silvestres de quinoa y cañihua en Bolivia*

[1] The United Nations conference held in Rio de Janeiro from the 3rd to the 14th of June 1992.

- *IFAD-NUS Bolivia*
- *Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA*

The department of La Paz is located in the inter-Andean valleys, close to the Eastern split of the Altiplano region. The most important microcenter of biodiversity in the area is the subtropical Yungas: basically constituted by mountain jungles, it offers great environmental diversity along different altitudinal zones (forests at the base, forests on the slopes and other forests and pastures on the peaks). The climate is warm and humid, with dry winter seasons, heavy summer rains, and winter snowfalls at higher altitudes. Historically, the Yungas have been the center of migration from southern Peru, a situation accentuated in the past 40 years by migration from La Paz itself, Oruro, Potosi and Chuquisaca. In the past, the establishment of thousands of Aymara and Quechua colonies has favored the movement of roots and other species up and down the Los Yungas. All this genetic movement occurred within the ethno-development of the region, therefore the community rural management and conservation of species is the only form of agricultural practices found in the area. La Paz department presents a great variety of roots, especially Arracacha, Yacon, and Mauka.

POTOSI

- *Sustainable production of quinoa: a neglected food crop in the Andean region*
- *Programa de apoyo a la cadena quinoa altiplano sur*
- *Green manure and legumes: integrating agronomic and health research for improving the production of food and diets in marginal areas of Northern Potosi*
- *Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA*

The Salar de Uyuni, which covers 61% of Potosi Department, and the entire Altiplano zone of Potosi are among the most important ecotourism destinations in Bolivia due to their beautiful landscapes. The mountainous areas of the Salar prevent rainfall from reaching the Altiplano, thus producing an arid to semi-arid climate. In the areas where rivers and lakes exist, there is a rich avifauna and vegetation cover. The activities that employ most of the economically active population in the basin are quinoa agriculture and camelid livestock. Even though 1% of the total area is suitable for agriculture, quinoa harvesting is the main source of income and food security for local people.

CHUQUISACA

- *IFAD-NUS Bolivia*

Located in centre south of Bolivia, Chuquisaca Department is traversed by the main Andean cordillera partly lies within the Amazon River basin. The topography of most of the Department is characterized by a series of steep parallel ridges that run north/south, separated by flat-bottomed valleys. The colonization pressure in the valleys, along rivers and roads, has left few large areas of forest remaining. The native inhabitants were the Charcas, who were dispersed along riverbanks and lowlands. Along with Potosí, Chuquisaca Department has the highest levels of chronic poverty in Bolivia, concentrated in rural areas.

ORURO

- *Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA*

The region is constituted by a lower Puna (3400 - 3800 m) and a high Puna (3800 to 4200 m) characterized by the presence of mountains and high plains. The dominant vegetation is grassland with cultivated areas mainly with native potato. The population keeps original forms of organization as Ayllus councils made up of farmers and communities that manage the potato-based food systems. The region's economy is based on mining and farming. The rural population consists exclusively of small farmers that cultivate land in small fragmented parcels. Rural families also conduct secondary cultural and economic activities such as artisanal crafts, mining and occasionally temporary migration to urban centers.

ECUADOR

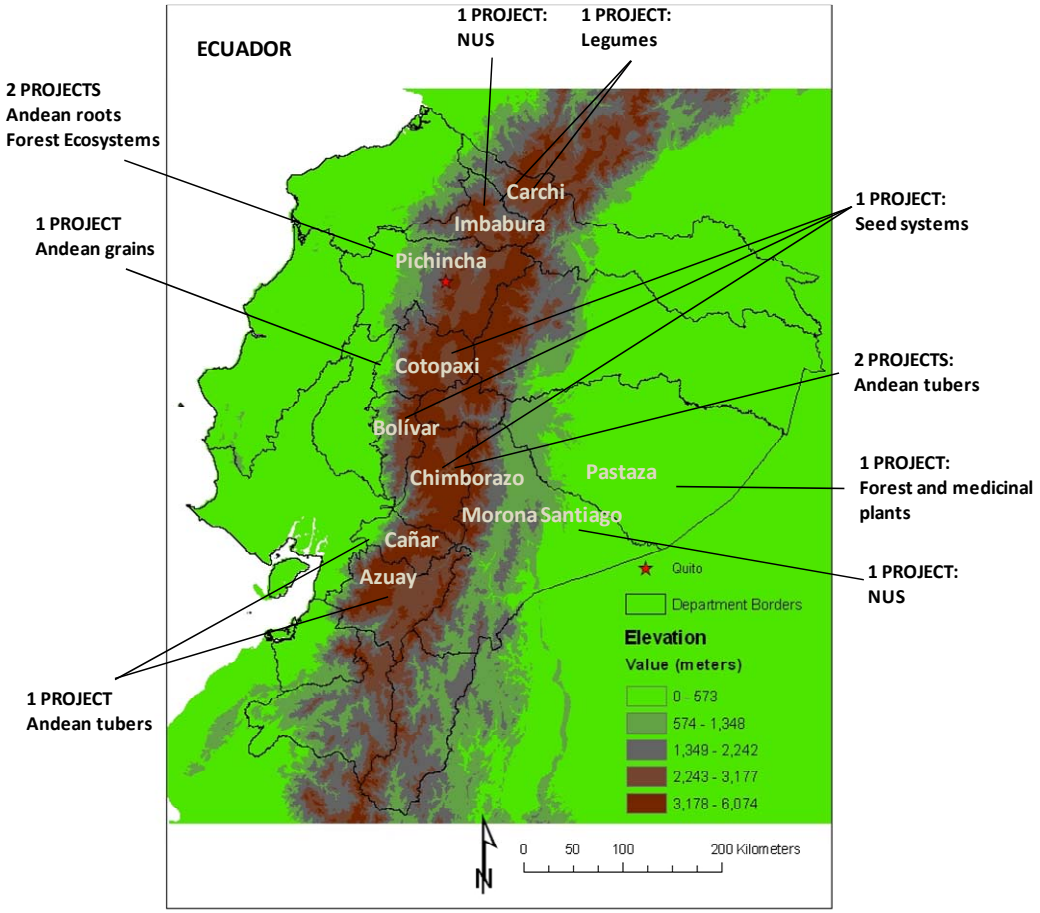


Figure 4: Distribution of projects by region and crops – Ecuador

Its geographic diversity, its location at the juncture of two ocean currents, and the relatively recent rise of the Andean mountain range, make Ecuador an extremely diverse country despite its relatively small area. Ecuador is characterized by four natural regions: the Galapagos or Archipiélago de Colón, the west coast, the Andean highlands, and the Amazon region (Kernan and Stern, 2006). Climate varies according to the topography of each area and temperature of the adjacent ocean currents. With nearly 25000 species of vascular plants, the four regions have an estimated endemism of 32.25%. The Galapagos region has 604 species of which 226

endemic; the coastal region counts for 6300 species of which 1260 endemic; the Andean region has about 10500 species, 2625 endemic; and the Amazon region has 8200 species of which with 1230 endemic (INIAP, 2008). The Andean Highlands cover only one fifth of the surface of Ecuador but almost 45% of the population lives in the fertile valleys along the Andes mountain range. Among the country's natural vegetation, there's richness in wild relatives of cultivated species, such as wild potato, beans, tomato, tropical and subtropical fruit (INIAP, 2008). Forests also contain wild relatives of species such as avocado (Persea spp.) and papaya (Carica spp.).

Soil degradation is considered one of the most serious environmental problems in Ecuador (Byers, 1990). In the Andean region, the natural vegetation has been almost entirely replaced by "modern" crops and urban settlements. The indiscriminate cutting of the forests not only results in the loss or extiction of timber forest species, but in the gradual disappearance of crops' wild relatives, such as wild potatoes, tree tomatoes, and Passiflora (INIAP, 2008). However, indigenous communities in rural settlements continue planting and preserving traditional varieties of different crops such as maize, potato, sweet potato, ulluco, oca, white carrot, quinoa, lupin, and beans for consumption and commercialization purposes.

While economic development has improved the lives of Ecuadorian people, it has also increased the extraction, transport and use of natural resources, causing the pollution of many water systems, replacement of many varieties by monocultures, and the construction of forest access roads, exacerbating deforestation. The country has the second highest rate of deforestation in the Americas (190,000 has for years) and almost 200 of its animal species are seriously threatened (UNDP, 2008). The loss of agro-biodiversity has been rapid: it is estimated, for example, that loss of genetic diversity in Chimborazo, Tungurahua and Canar ranges from 12% to 40%.

The main causes for the reduction of the base of natural resources and environmental degradation relate to the inequality in access, use and management of natural resources, high dependence on natural resources by the economy, and unsustainable production and consumption practices. Agricultural activities still occupy about 30% of the population economically active, generating about 90% of food for domestic consumption and raw materials for processing. The country's population - about 13.5 million - consists of four broad groups (Mestizo 65 %; Amerindian 25 %; Spanish 7%; and Afro-Ecuadorian 3%). Amerindian groups play a particularly important role in the conservation of Ecuador's biodiversity and tropical forests since many of them control large areas of forested land. Each of these groups has a distinct culture. Many conflicts arise among the different groups and with indigenous people, divided geographically, socially and politically. This social and political unrest reflects badly on environmental protection strategies, also blocking environmental and biodiversity legislation (Kernan and Stern, 2006).

In spite of this, some efforts have been made to avoid degradation of nature, including environmental legislation such as a Special Regime for the Province of Galapagos, and the Environmental Management Act. Moreover, positive practices can be found in community management of natural resources, particularly in the case of indigenous communities, and small-scale environmentally friendly production activities by local government and the private sector.

CARCHI

- *Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)*

The province of Carchi represents the highest potato producing area nationwide (providing 40% of the country's annual harvest) thanks to its variety of climates. The production system is characterized by small-scale farmers producing mainly potato, followed by other crops (wheat, barley, corn, bean and pasture). Most small producers prepare the ground with different tools (tractor, manual, and yoke) depending on the planting season, topography, soil and availability of machinery. Farmers plant throughout the whole year, due to the homogeneous distribution of rainfall, and use high amounts of external inputs such as insecticides, fungicides

and fertilizers. Generally, farmers use family or hired labor in times of higher demand, especially during planting and harvesting. The area of Carchi has high levels of poverty and historical deficiencies in basic social services and infrastructure.

IMBABURA

- *Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)*
- *Conservacion complementaria y uso sostenible de cultivos subutilizados en Ecuador. Rescate, promocion y uso de recursos fitogeneticos interandinos del Ecuador*

The province of Imbabura produces several products belonging to different climates from cold to tropical and subtropical ones. The Andean zone of Cotacachi especially is a microcenter of genetic diversity managed for millennia by indigenous people and 'mestizos'. Basic infrastructure is lacking, although farmers own irrigation systems. Farms are small and characterized by three basic components: the house, crop agro-ecosystem and animal agro-ecosystem. Production is based on Andean grains such as corn and beans in the northern and central sector, with milder climates and where over 95% of production is sold; while in the cold southern sector, many families have no access to any services and 90% of production goes to consumption. Rural areas in the province are characterized by unequal distribution of land and unemployment.

PICHINCHA

- *Promoción de Cultivos Andinos: "Desarrollo de Agroindustrias y Mercados para la Arracacha"*
- *Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el Noroccidente de Pichincha*

The province of Pichincha is located in the central region of the sierra between the two *cordilleras* of the Andes. The climate in Pichincha is varied: from intense coldness on the Andean *paramos* to the warm subtropical zones on the flanks of the western cordillera. In the upper plains and valleys the temperature is mild, sometimes with high humidity levels. The province of Pichincha has a high production rate of bananas, coffee, barley, corn, maize and potatoes. Pichincha is also the primary producer of wheat in the country. The land is fertile, mainly composed of volcanic materials and rich in minerals. The low agricultural production obtained on farms is used for self consumption of local foods. The service sector is the leading industry, followed by manufacturing and agriculture. The rate of population growth in the province is among the highest in the country.

COTOPAXI

- *Lupin/quinoa: sustainable production systems to guarantee food security in impoverished communities in the province of Cotopaxi, Ecuador*
- *Seed systems. The biological foundations of security in the Andes*

Situated in the central area of Ecuador, the province of Cotopaxi has a varied climate with humid, rainy and sub humid tropical weather systems. This variety is due to its extension from cold Andean peaks to the humid heat of subtropical zones. Due to its varied climate, natural resources are abundant and products various; soils are fertile and rich in minerals and other materials. The *molle* tree is the symbol of the province and there is also a variety of cypress trees, walnut trees, *alisos* and *arrayanes.* In the subtropical zone rubber, oak, *tagua*, laurel, *guayacan* trees are highly exploited. Cotopaxi is a typical Andean province where small farms are the

backbone of rural livelihoods. Potatoes are the most important product particularly on the south-eastern *paramos*. Yuca, onions, avocados, barley, oranges, corn, broad beans, beans and sugar cane are also cultivated in the area. Agriculture and cattle farming are the most important sources of economic income in the region, artisan manufacturing (often indigenous) and pottery also flourish in the area.

CHIMBORAZO

- *Proyecto Integral Las Huaconas*
- *Potato moth. Biopesticide development and diffusion of potato moths*
- *Seed systems. The biological foundations of security in the Andes*

Chimborazo has the largest area under potato crop nationwide, but with low yields. There are three potato producing areas in this province, west, northeast and central mountains. Small farmers with small arable land (0.5-1 ha) make shorter rotation periods, while medium (1-5 ha) and large (5-50 ha) producers renew their pastures for livestock with potato, returning to this crop every eight to ten years. The most common system of rotation is potato-bean, pea, barley, and oats-fallow or pasture (1-3 years). Principle produce includes cereals, vegetables, potatoes, fruits and medicinal plants. The climate of the province is very heterogeneous. The hot winds of the Amazon affect the stretch of the Cordillera Oriental, softening its climate. As a result of strong variations in altitude (between 2200-3600 m) and rainfall, average temperatures range between 6° and 15°C, which has generated a wide diversity of ecological zones.

AZUAY & CAÑAR

- *Uso, manejo y conservación in situ de tres variedades locales de papa en el Austro Ecuatoriano*

Previously united under one province with Cañar, the Azuay province is characterized by strong migratory movements from the countryside to the city. In Azuay, the land is rich in minerals, including important deposits of lead, silver, zinc and even uranium. Gold mining is also practiced in some of the regions' rivers with old-fashioned practices. Azuay is well-known for its artisan tradition, in particular for handicrafts in wool and cotton, cabinetwork, shoe-making, and straw-hat industry. Marble and clay are natural resources that have been exploited for years, making pottery a relevant resource of the province. The soil is not as fertile as in other provinces as there is no volcanic material in the earth. Despite this, agriculture is a traditional activity. Due to low rainfalls, potato is not a relevant crop in the region, and rotation includes maiz, peas, beans and native grass. Other Andean crops, such as mashwa, oca and ulluco, are alternated with natural or artificial pasture. In the southeast subtropical fruits such as banana, mango, papaya and granadilla are produced.
Cañar is rich in copper, zinc, silver and lead and has a very good climate and land for growing potatoes, ullucos and ocas. Agricultural production alternates with cattle farming due to the soil's fertility levels. The lower inter-Andean zone has been affected by severe erosion due to rainfall and rapid deforestation. Agricultural production is the area's principal industry and migration from the area is low. A high percentage of residents lack sufficient water supplies and the sewage system is limited.

PASTAZA

- *Conservation of biodiversity in Pastaza*

Pastaza is mainly occupied by indigenous communities (138 communities), in which reside most of the illiterate population in the Province. Health services are also extremely deficient, particularly in urban small centers. The loss of traditional cultivars has caused a significant decrease in the quality of food, resulting in high incidence of child malnutrition and contagious diseases. Market-oriented cattle breeding resulted in

deforestation, water pollution and decline of traditional livelihood subsistence resources such as hunting and fishing. Both modem agricultural and livestock technologies are eroding the forest soil conditions, promoting deforestation and accelerating the traditional knowledge loss.

MORONA SANTIAGO

- *Conservación y manejo de la agrobiodiversidad en la cordillera del Cóndor*

The population of Morona Santiago is the product of the colonization of the provinces of Chimborazo, Cañar and Azuay. In urban areas of the province migration has generated a rapid growth of population making it the largest population in the Amazon. The lush vegetation of the plateaus and valleys of the region is determined by different climatic zones with mild tropical and subtropical temperatures. The cordillera Del Condor, on the border with Peru, is extremely divers in flora and fauna, with 38.5% of mammal species, 13% of amphibians, 38% of birds and about 10% of plant species recorded in Ecuador. The region is especially important for its biodiversity because of the high levels of endemism. The cordillera Del Condor is also part of the homeland of Shuar communities (partly Ecuadorian and partly Peruvian), who find themselves in conflict with mining and hydroelectric concessions as the territory is known for gold and other precious minerals. The area was the location of a long-running territorial dispute between Ecuador and Peru, solved in 1998 with the symbolic creation of small peace parks.

PERU

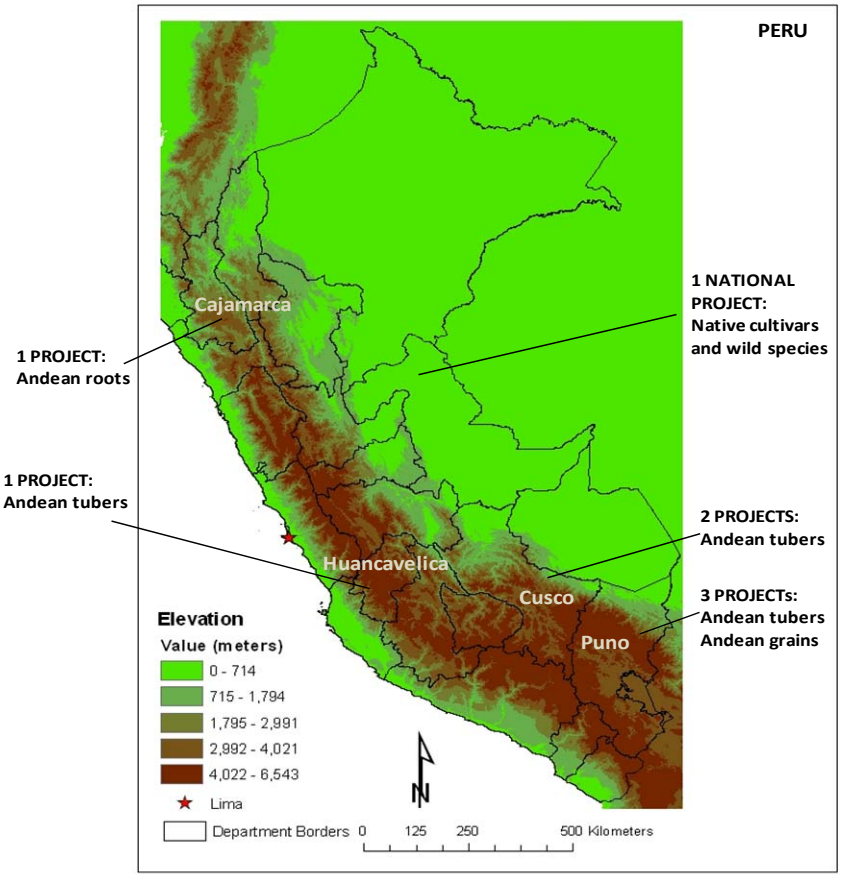


Figure 5: Distribution of projects by region and crops – Peru

Peru is among the five countries with the greatest biological diversity and variety of climates and natural environments in the world (The Nature Conservancy, 2007). Up to date figures report 25,036 species of flowering plants and vertebrates, of which approximately 5,763 species (23%) are endemic. Such high biological diversity stems from the country's tropic and equatorial geographic location, the variety of climates, and ecosystem types. By example, Peru has 1.816 bird species (115 endemic), 515 mammal species (109 endemic), and 3.200 orchid species (10% of the world's orchids).

According to INRENA (2007), Peru can be divided into four main geographic regions: marine, coastal plain, highlands, and the Amazon basin. The marine region is characterized by a cold, nutrient rich Peruvian current eco-region, and a warm, high diverse Tropical current eco-region. The coastal plain contains Pacific/desert hills with very low rainfall and often extremely dry desert; a dry equatorial forest; and a Pacific equatorial forest. The highlands are characterized by Andean pastures in the Puna with severely degraded soil, brushlands in the western Andean steppe, and Paramo high plateau. Finally, the Amazon basin can be divided into a moist "Selva Alta" or cloud forest, a "Selva Baja" or lowland forest with fertile soils, and the flat area of the Chaco Savanna pampas (USAID, 2007).

Ecosystem and species diversity in Peru is accompanied by a multicultural diversity of over 65 ethnic groups present in the country. The 7.000 indigenous communities representing 9 million "native" people, can be divided into three main groups: Quechua, Aymara and Amazonian. Most of them live in rural "Comunidades Campesinas", or peasant communities, which form the basis of social organization in the Peruvian Andes and are officially recognized by the national government. These communities manage approximately 40% of the

total agricultural and pasture land in the country, differing in terms of access to resources, internal organization, and cultural traditions (Grupo Allpa, 2009). They represent the poorest segment of the population, mostly living between 2,000 and 4,000 meters above sea level in the Quechua and Suni regions, and experiment, produce, reproduce, and nurture their native seeds in peasant's fields of 1 to 2 hectares (so called chakra). From these small plots scattered throughout the Andes, they collect native seed varieties of Andean roots, tubers, and grains.

The legal framework for biological diversity in Peru is represented by the Law of Conservation and Sustainable Use of Biological Diversity and its Regulation D.S.O48-2000-PCM, with mandatory sectorial and development plans, programs and projects.

HUANCAVELICA

- *In-Situ Conservation of Native Cultivars and Their Wild Relatives – Peru*
- *Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica, Peru*

Huancavelica is one of the poorest regions of Peru, with 86% (of the 400,000 population) living in poverty and 45% of children malnourished. However, it is also one of the most diverse regions of Peru in terms of ecosystems, species and varieties. Climate varies from hot and dry in the west part to temperate and humid in the east, and to cold and humid in the forests, *paramos* and tundra. The most common cultivars are the potato (papa) with more than 800 kinds, followed by other tubers and roots such as oca, ulluco and arracacha. The percentage of population employed in agriculture varies between 60% and 86%. Farmers are smallholders, with low technology use, no access to credit or to markets. Historically, agriculture and mining are the main sources of income in the region.

CAJAMARCA

- *In-Situ Conservation of Native Cultivars and Their Wild Relatives – Peru*
- *Promoción de Cultivos Andinos: "Desarrollo de Agroindustrias y Mercados para la Arracacha"*

Cajamarca is characterized by different ecosystems, with a predominance of forest. Climate is varied, cold in the Andean highlands, temperate in the valleys and warm in the surroundings of the Marañón River. Temperatures are high during daytime and low at night, often falling to 0°C above 3000 m. Rainfall is abundant in the summer season. Cajamarca hosts 948 endemic taxa of flora, has a diversity of forest ecosystems, *paramos*, valleys, cloud forests and coastal communities, many of which are threatened by inappropriate uses that are generating large losses of biodiversity. Almost 70% of the population in the region is rural; recently mining activities have increased.

CUSCO

- *Native Potato: improved production of native potatoes in the Andean highlands of Peru*
- *Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands*
- *IFAD NUS - Peru*

The department of Cusco is characterized by several life zones and microclimates ranging from highlands over 6,000 m to the low jungle in the Amazon, and the east slope of the Andes, which is extremely rich in

biodiversity. Given the importance of conservation and preservation of these natural resources, the department of Cusco has several protected and intangible areas declared World Heritage. The climate in Cusco is influenced by large air masses from the south eastern jungle, the highlands and even the distant region of Patagonia. Weather is hot and humid in lowland areas, hot and dry in the Yungas, temperate in the inter-Andean valleys, and cold on the mountains and *punas*. In the department of Cusco, advanced and backward areas coexist, with poverty incidence higher among Andean indigenous communities.

PUNO

- *Proyecto Integral Altiplano*
- *IFAD NUS – Peru*
- *Desarrollo Sostenible de Quinua Orgánica en el Perú*

The Puno region of southern Peru has among the highest poverty rates in the country as well as high rates of child malnutrition. Given the area's harsh climate, farming is difficult and practiced mainly on a subsistence level. The Peruvian-Bolivian Altiplano is part of the Titicaca basin, with average altitudes of 3,800m. Floods and droughts are common in different times of the year, the first during seeding season and the second in the harvesting season. Temperatures range from -4°C to 18°C and are mitigated in the area around Lake Titicaca. The Altiplano is characterized by severe frost and drought problems, which farmers, usually smallholders, tackle creating several plots with various crops alternated to rest areas, used for grazing, diminishing risks. In both countries the potato is the main crop and occupies the largest cultivated area, followed in order of importance by barley, quinoa, Andean tubers and beans. Native species have high genetic variability usually planted as varietal mixtures in the same plot. Cropland and dairy areas are concentrated around Lake Titicaca, which provides thermal regulation; while alpacas and sheep production is the main activity throughout the Altiplano.

AGRO-ECOLOGICAL CHARACTERIZATION OF ANDEAN CROPS

Andean crop varieties have a long history as part of the ancestral production systems of pre-Hispanic societies, adapted to the harsh conditions and highly variable climate of the region. They are crops of high nutritional value, the consumption of which has been culturally marginalized and replaced by commercial crops. Today they represent complementary crops for poor families and are usually produced with a low use of pesticides and chemical fertilizers.

The cultivation of crops of Andean origin is limited by the lack of continued support for research and promotion. Their nutritional value and different uses are not widely known, which is why their consumption is often limited to producers in remote areas and not spread among the population. Moreover, market supplies of Andean crops are often limited to producer areas; processing methods are still unsophisticated; prices are often too low and costs too high due to traditional agro-industrial techniques.

Box 1: Altitudinal distribution of Andean crops

Altitudes between 3000 - 4400m
- Andean Tubers: oca, mashwa, bitter potatoes (papa), ulluco
- Other Tubers: used in native potato rotation systems
- Andean roots: maca, leafcup
- Andean Grains: cañihua, quinoa

Altitudes between 2500 -3500m
- Andean roots: mauka, achira
- Andean Legumes: lupin

Altitudes between 1500 - 3000m
- Andean Grains: love-lies-bleeding
- Andean Fruits: pepino, tree tomato, mountain papaw
- Andean roots: arracacha, yam bean

The co-existence of fertile inter-Andean valleys with mild climates with fields situated at high altitudes exposed to cold weather has made agricultural biodiversity in the Andes extremely diverse (Box 2 shows the distribution of Andean crops by altitude). The pre-Hispanic Andean population was able to use this ecological heterogeneity building the foundation of "peasant varieties", or else called "landraces" (Tapia and de la Torre, 1997). As shown in Table 1, these comprise maize and potato crops, but also other species of tubers (oca, ulluco, mashwa), roots (arracacha, leafcup, chagos, maca), fruits (pepino, tomato tree, goldenberry) and condiments (chilies and roqoto). This plant diversity favored the development of an indigenous agriculture adapted to the different and difficult ecological environment of the region, ensuring adequate nutrition for the population.

Table 1: Andean Crops

	CROP	SCIENTIFIC NAME	COMMON NAME	ADAPTATION AREA	AGRO-ECOLOGICAL ZONE	TAXA
TUBERS	Mashwa	Tropaeolum tuberosum	Mashwa, Mashua (Peru, Ecuador), Isaño, Añu (Peru, Bolivia), Maswallo, Mazuko, Mascho (Peru)	High Mountains	Suni, puna	Morphotype
	Oca	Oxalis tuberosa	Oca (Peru, Ecuador)	High Mountains	High quechua, suni	Morphotype
	Ulluco	Ullucos tuberosus	Melloco (Ecuador), Olluco, Ulluco, Lisa, Papalisa (Peru), Lisa, Papalisa (Bolivia)	High Mountains	High quechua, suni	Morphotype
	Papa	Solanum tuberosum	Papa	High Mountains	Yunga, quechua, suni, lake shores, eastern slope	Morphotype
ROOTS	Arracacha	Arracacia xanthorrhiza	Arracacha, Racacha, Zanahoria Blanca (Spanish)	Low Mountains Medium Mountains	Yunga, low quechua	Morphotype
	Maca, Pepper Grass	Lepidium meyenii	Mace (Peru)	High Mountains High Plateau	Puna	Morphotype
	Leafcup	Smallathus sonchifollius	Yacón, Yacuma, Jícama (Ecuador, Bolivia), Jícama (Peru)	Medium Mountains High Mountains	Yunga, low quechua	Morphotype
	Mauka, chagos, miso	Mirabilis expansa	Chago, arricón, yuca, inca, cushipe, chaco (Peru), miso, taso, pega pega (Ecuador)	Medium Mountains	Yunga, quechua húmeda	
	Achira	Canna edulis	Achira	Low Mountains Medium Mountains	Yunga, low quechua	Morphotype

	Yam bean	Pachyrhizus tuberosus	Ajipa	Jungle Low Mountains		Morphotype
	Sweet potato	Ipomoea batata	Camote	Coast		Morphotype
	Cassava	Manihot sculenta	Yuca	Jungle		Morphotype
GRAINS	Cañihua	Chenopodium pallidicaule	Qaniwa, Cañihua (Peru), Canahua (Bolivia)	High Mountains	Suni, puna	Breed
	Love-lies-bleeding	Amaranthus caudatus	Kiwicha, Achita, Achis, Coyo (Peru) Coimi, Millmi (Bolivia) Sangoracha, Ataqo (Ecuador)	Medium Mountains High Mountains	Quschua	Breed
	Quinoa	Chenopodium quinoa	Quinua, Kiuna (Ecuador, Peru, Bolivia), Jiura (Bolivia)	Medium Mountains High Mountains	Quechua, suni, yunga, lake shores, eastern slope	Breed
	Maize	Zea mays	Maíz	Coast Medium Mountains High Mountains	Yunga, quechua, eastern slope	Breed
LEGUMES	Lupin	Lupinus mutabilis	Tarwi (Peru,Bolivia), chocho, chochito (Ecuador and northern Peru), ccequela (Peru), chuchus (Bolivia)	Medium Mountains High Mountains	Quechua, lake shores	Variety
	Poppin bean	Phaseolus vulgaris	Frejol, Ñuna	Coast Low Mountains Medium Mountains	Yunga, quechua	Variety
	Lima bean	Phaseolus lunatus	Pallar	Coast		Variety
	Peanut	Arachis hipogea	Mani	Jungle Coast		Variety
CUCURBITACEAE	Butternut squash	Cucúrbita moschata	Calabaza (Chiclayo)	Coast Low Mountains		Breed
	Banana squash	Cucúrbita máxima	Zapallo	Coast Low Mountains		Breed
VEGETABLES	Hot pepper	Capsicum annum	Aji	Coast Low Mountains		Variety
	Tomato	Lycopersicum esculemtum	Tomate	Coast Low Mountains		Variety
	Apple chili	Capsicum pubescens	Rocoto	Coast Low Mountains		Variety
FRUITS	Sweet granadilla	Passiflora ligularis	Granadilla	Low Mountains Medium Mountains		Ecotype
	Pepino	Solanum muricatum	Pepino dulce	Low Mountains	Yunga	Ecotype
	Camu-camu	Myrciaria dubia	Camu-camu	Jungle		Ecotype
	Tree Tomato, tamarillo	Cyphomandra betacea	Tomate de árbol, berenjena, sachatomate, yuncatomate	Low Mountains Medium Mountains	Yunga, quechua	

			(Peru), limatomate, tomate de monte, tomate de La Paz (Bolivia, Argentina)			

In the following paragraphs we draw a brief description of Andean crops by class referring to different sources (National Research Council, 1989; Bermejo and León, 1994; Tapia, 2000; Tapia and Mateo, 1987), each followed by a summary description of the projects relative to those crops, in order to have an overall view on the interventions carried out. The multiplication, productivity and promotion of Andean crops are the objective of most of the projects we have studied, which have tried to develop or introduce varieties more acceptable at cultural and consumption level, and with desirable agronomic and productive characteristics.

ANDEAN ROOTS AND TUBERS

Many roots and tubers have their origins in the high mountains of the Andes. Indigenous people have cultivated and improved them since many centuries. Andean roots and tubers in fact present high yields in poor soils under adverse climatic conditions as well as tolerance to various plagues and diseases. However, these traditional crops are being superseded by market integration and higher yielding species with better market potential. Production concentrated on the few varieties of potatoes widely accepted by the market. Agronomic development, monocropping tendencies and poor use of modern agricultural inputs have also affected agro-ecosystem viability and increased pest damage.

Among the most studied Andean plant genetic resources are the potato species. In fact, the region of Lake Titicaca is recognized as the potato's place of origin, making the Andean highlands of Bolivia and Peru the most potato diverse region in the world (FAO, 2008). There are over 5,000 varieties, with different shapes, sizes, colors, skins, textures and flavors. After 8,000 years, the potato is still the staple food of the people of the Highlands and their main crop in terms of calories and income (COSUDE, 2010). Potato species represent promising cultivars for small farmers although they suffer from diseases, parasites and climatic factors such as drought, heavy rains, frost and hail. Rotations and associations with other crops (like faba beans and lupin) help reduce pests. But the seeds themselves are high risk factors and can carry diseases, viruses, fungi, bacteria and contaminate fields and markets. For that reason, it is essential to use healthy seeds of good quality. Potato biodiversity is under threat as ancient varieties cultivated for millennia by Andean peoples have been lost to diseases, climate change and social upheaval.

Most Andean tubers face serious storage problems, mainly due to seasonality. In some periods of the year there is overproduction and in others, usually longer, scarcity of supply. Consequently, the economic losses due to bad storage and harvested product processing are substantial (CIP, 2001).

Andean roots and tubers (RTAs) play an important role in the nutrition and health of the Andean population. They are sources of nutrients and of secondary metabolites with increasing value in the market. Farm families are the guardians of the biodiversity of RTAs. Both utility and tradition are among the reasons these families preserve and protect their cultivars. Therefore natural factors, socio-economic and socio-cultural habits play a role in the decision whether to preserve, multiply or abandon the germ-plasm of cultivars.

The three Andean tubers on which projects focus (oca, mashwa and ulluco) are grown in the same agro-ecological zone and their soil requirements and cultivation practices are very similar to those of the potato. In the northern area of the Peruvian sierra the traditional form of cultivation is on *melgas*: after cultivation of the potato, the land is divided into three to five plots, each of which is sown with one of the Andean tubers. On the high plateau of Puno and in the agro-ecological zone of the semi-humid puna, a mixture of tubers is sown. By contrast, in the quechua agro-ecological zone, the oca and ulluco are planted together with maize. These crops show a high response to agricultural work such as fertilization, earthing up, hoeing and, above all, the control of pests and diseases; their production increases to levels of 40 to 50 tonnes per hectare, which are

comparable to the highest potato yields. The Andean tubers perish easily, which explains why ancient Andean peoples attempted to store surpluses by freezing and drying, processes used also for the ulluco.

Tropaeolum tuberosum

Mashwa: is probably the Andean region's fourth most important root crop—after potato, oca, and ulluco. Mashwa has an important role in meeting the food requirements of resource-poor people in remote rural areas of the high Andes. Its culinary uses vary from to roasts and *thayacha* (overnight frozen tubers eaten with sugar-cane syrup). From an agronomic point of view, mashwa is a very resistant crop growing on poor soil, without fertilizers and pesticides. Among Andean tubers, mashwa is one of the highest yielding, easiest to grow, and most resistant to cold. Even under bad weather and soil conditions it can produce twice the yield of the potato. In spite of its productivity, pest resistance, and popularity, mashwa is not widely commercialized, and in the Andes it is usually associated with poverty.

Oxalis Tuberosa

Oca: thanks to its low protein and fat content, Oca is a good source of energy. Sun-dried to make it sweeter it can be parboiled, roasted or prepared as *pachamanca* (meat roasted in a hole in the ground). The dried frozen tuber washed after freezing, is used to make superior quality flour for porridges and desserts. Despite the fact that oca is an important food and cash crop in upland Andean areas, it suffers cultural scorn because it is considered a "poor man's" plant. Virus infections are a major constraint, but the potential to increase its yield through better agronomic practices could make it an optimal alternative source of flour to wheat.

Ullucus Tuberosus

Ulluco: of the three Andean tubers (mashwa, oca and ulluco), ulluco is the most popular and well established in the diet of both the rural and urban population in Ecuador, Peru and Bolivia, however its carbohydrate and energy content is slightly less than that of most tubers. Traditional preparations include *mellocos* soup (Ecuador); *olluquito con charqui* (*ulluco* with meat - Peru), *chupe* (potato, meat, egg and cheese stew) and *ají de papalisas* (ulluco pepper—Bolivia and Peru). Viral infections and deseases are the main constraint for the widespread cultivation of this crop.

Potatoes are scarce in town markets during years of drought or frosts in the high areas of Andean regions, and they are replaced by roots like arracacha, cassava, sweet potato, tannia (Xanthosoma sagittifolium), cocoyam or dasheen (Colocasia esculenta) and yam beans (Pachyrhizus spp.). Hereafter we provide a brief description of the most important roots of Andean origin.

Canna edulis

Achira: The achira is a very hardy plant grown mainly in the Yungas region of La Paz and Cochabamba, and the valleys of Chuquisaca and Tarija. Outside the Andes it is grown in Hawaii, Australia, Vietnam, Taiwan and Indonesia. The rhizome is an important source of starch, with characteristics very similar to maize. Its starch is easily digested and is used in foods for infants, the elderly or people with digestive problems. It also contains protein and minerals like calcium, iron, phosphorus and vitamin A. This starch can be used in cakes, muffins, noodles, as a thickener for soups, dietary products, as well as pharmaceutical and textile industry. Its marginalization is due to agronomic limitations, scarce promotion of its multiple properties and lack of technologies for large production.

Arracacia Xanthorrhiza

Arracacha: Arracacia xantorrhiza or Inca root is a species of Andean root which has replaced the potato in the diet of many Andean people. In the areas where it is produced it is part of the basic family consumption basket, where the leaves, stem and root are

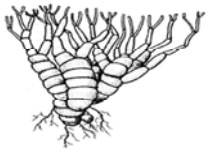
used in both human consumption and animal feed. The most appreciated part is the root, for its nice taste and important nutritional characteristics (easily digestible starch, high in calcium, phosphorus, and Vitamin A) (CONDESAN, 1998). The crown of the root is used dairy cattle, swine and small animals feed. For these features arracacha is a crop that provides good economic prospects in the Andean countries. The marginalization of this root depends on the socio-economic context of its growers and secondarily on some agronomic constraints, such as susceptibility to pests and diseases and the difficulty of storing its roots.

Smallathus Sonchifollius

Leafcup (Yacon): the very low consumption of leafcup (yacón) in urban areas has led to an absence of intensive production techniques resulting in the marginalization of the crop. However, its commercialization is especially wide in the northern areas of La Paz department. The pleasant-tasting sweet roots are sun-dried eaten and eaten raw. The root is high in fructoligosaccharids (FOS), which are polymers of fructose that can not be hydrolyzed by the human body and pass through the digestive tract without being metabolized, providing lower calorie sucrose. This product is therefore easy to digest and great for low calorie and diabetic diets. Cattle and pigs also eat the roots together with the foliage. However, Leafcup provides little in the way of human nutrition. It is consumed for flavor and variety rather than for sustenance. Outside its native region, yacon is little known either in agriculture or as food. In spite of this, the leafcup could acquire importance as a perennial fodder and cover crop in arid conditions as a component of multiple complementary crops.

Lepidium Meyenii

Maca: this Andean root can be found only in the central sierra of Peru in the departments of Junín and Pasco, in the puna agro-ecological zone above 4000 m where low temperatures and strong winds limit other crops. Its subterranean part (hypocotyl) is edible and highly valued for its richness of proteins and minerals. Dried, the roots can be stored for years. They are often exchanged with communities at lower elevations for staples such as rice, and they reach markets as far away as Lima. The sweet, spicy, dried root is considered a delicacy. Maca boiled in water is sweeter than cocoa. In Huancayo, Peru, maca pudding and maca jam are popular. However, the methods of horticulture are complex and labor intensive, and maca is peculiarly adapted to the climate of the puna. Its commercial potential lies in its stimulant properties, in which rural communities strongly believe.



Mirabilis Expansa

Mauka: greatly valued in the communities of temperate valleys at around 2800 m for human consumption and animal feed, this crop is maintained in a marginal way in small vegetable gardens. It is cultivated alon or combined with maize and cucurbits or other plants, remaining in the field for several years as a result of the transplanting of vegetative parts. The protein, calcium and phosphorus content is higher than in other roots and tubers grown in the same agro-ecological area, making it advantageous for the Andean diet, frequently deficient in calcium and phosphorus. The upper part of the root and the lower part of the stem are edible. These swollen thickened clumps, similar to those of cassava, are usually boiled or fried and served as vegetables. Like other *Mirabilis* species in the Andes, mauka is used as a feed, mainly for guinea pigs.

Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (Raíces y tubérculos andinos- RTAs)

The Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops was developed in five countries: Bolivia, Brazil, Colombia, Ecuador and Peru. The program is funded by the Swiss Agency for Development and Cooperation (SDC) with the support of the International Potato Center (CIP), the International Plant Genetic Resources Institute (IPGRI), and the participation of various institutions working for the conservation and use of biodiversity. The program was implemented in three phases: 1993 to

1997 (CIP, 1998), 1998 to 2000 (CIP, 2000), and 2001 to 2003. The first phase focused on a participatory research over Andean roots and tubers (RTAs) to increase the knowledge on their level of biodiversity and concentrate efforts on the conservation of germ-plasm, improved sowing practices, and understanding of production/consumption patterns to develop new market opportunities. This phase included research on *in situ* and *ex situ* conservation, virus cleaning and basic seed production of tuber crops in rural communities. As a result of the first phase microcentres of biodiversity were selected, as well as products with greater productive potential. In the second phase, four integrated projects were developed around common action lines in areas on diversity and production of RTAs. Program activities covered various topics of the chain production, from the conservation of genetic resources to processing and consumption, taking into account traditional craft and modern methods. Market research development and consolidation was then considered an important step to value diversity and support its conservation. These efforts led to the consolidation and establishment of the National Bank of Andean tubers located in the EE-Andenes (Cusco), the INIA in vitro bank (La Molina), and the development of production centers of high quality seed, in order to link *in situ* and *ex situ* conservation and sustainable use of genetic diversity of the RTA's. The third phase aimed at the consolidation, analysis and publishing of the results of the first two phases.

Of the projects carried out in the second phase, we have analyzed three: *In situ conservation of Andean tubers in the micro-center of Candelaria* (Bolivia)*, Proyecto Integral Las Huaconas* (Ecuador) and *Proyecto Integral Altiplano* (Peru/Bolivia). We have also studied a fourth project correlated to the Collaborative Program and aimed at the conservation and use in Bolivia, Ecuador, and Peru of a specific Andean root, the Arracacha (*Promoción de Cultivos Andinos: "Desarrollo de Agroindustrias y Mercados para la Arracacha"*).

The programme started in Bolivia, Ecuador and Peru in 1993, with the aim to improve the quality of life of rural Andean families, through competitive production of roots and tubers and conservation of biodiversity. Participating institutions worked on marketing constraints and diversification of the uses of RTAs focusing on seven crops (ulluco, oca, mashwa, papa, ulluco, arracacha, and mauka).

Project activities were developed around a common framework:

- To synthesize and generate a methodology for developing valid traditional agro-industries in the Andes.
- To identify pilot areas where promising traditional activities could be strengthened
- To strengthen the institutional capacities of partners at the Andean countries in technical and social aspects related to agribusiness development

1. PROYECTO INTEGRAL LAS HUACONAS

Country: Ecuador

Organization: INIAP, DENAREF, CIP, SDC

Budget: Total cost of the Collaborative Programme US$ 9.6 million in 10 years

DESCRIPTION OF THE INTERVENTION

The project's objective is to conserve Andean tuber morphotypes in Las Huaconas and restore accessions which have undergone a process of genetic erosion..

Specific objectives:

1. *In situ* management of RTAs and preservation of natural resources
2. Production and distribution of quality seed
3. Agro-industrial application and artisanal production of processed RTAs
4. Market research and promotion of consumption of RTAs
5. Technology transfer and training on RTAs

Activities:

1. *In situ* management of RTAs and preservation of natural resources through integral biodiversity management, trails, fairs
2. Production and distribution of quality seed virus-free
3. Agro-industrial application and artisanal production of processed RTAs

4. Market research and promotion of consumption of RTAs
5. Technology transfer and training on RTAs

RATIONALE OF THE INTERVENTION

Currently, *in situ* conservation in Ecuador is executed primarily by indigenous communities, with small and scattered efforts by other actors. Strengthening the capacity of farmers and local organizations would increase the conservation of farm genetic resources, improving livelihoods of farmers and ensuring food security for future generations. Conservation based on active participation of the farmer's family, which involves the maintenance of traditional varieties or cropping systems within traditional agricultural systems requires a series of activities such as: the study of population biology, socio-economic studies, market research, participatory breeding farm, etc.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

The initial diagnosis of genetic erosion (agro-socio-economic surveys) and collection of tuber samples for this study was conducted in communities in the province of Chimborazo, in order to identify the degree of loss of diversity in the area of Las Huacones. The results of the participatory appraisals identified the Las Huaconas sector as an agro-ecosystem with potential for the *in situ* conservation of RTAs. The communities to work with were chosen based on a diagnosis of the region and through meetings with farmers (participatory rural diagnostic).

2. PROYECTO INTEGRAL CANDELARIA

Country: Bolivia

Organization: PROINPA, APROTAC, CIP, SDC

Budget: Total cost of the Collaborative Programme US$ 9.6 million in 10 years

DESCRIPTION OF THE INTERVENTION

The aim of the project was to generate new market opportunities for the Bolivian potato sector, especially for native potatoes, through Participatory Market Chain Approach, and to understand actions that allow sustainable processes of *in situ* conservation, production, commercialization and consumption of Andean tubers.

Specific objectives:

1. Developing strategies for production, management and biodiversity conservation of RTAs.
2. Revaluating traditional technologies and implementing new processing technologies
3. Promoting Andean tubers in the city of Cochabamba.

Activities:

1. Developing strategies for production, management and biodiversity conservation of RTAs through the incorporation of the production chain approach, establishment of farmers' organizations and fairs
2. Revaluating traditional technologies and implementing new processing technologies through studies
3. Promoting Andean tubers through cookbooks and campaigns

RATIONALE OF THE INTERVENTION

The area of Candelaria, located in the Department of Cochabamba (Bolivia), is known for its traditional farming system of Andean tubers. It presents a high concentration of native oca, ulluco and mashwa varieties and has been recognized as a microcentre of diversity for Andean tubers conservation. Unfortunately, this valuable germ-plasm seems to be under threat of genetic erosion.

Andean tubers have high yields even in poor soils and under adverse weather conditions, besides being tolerant to various pests and diseases. In Cochabamba, the town of Candelaria is considered a center of biodiversity where these tubers are stored ancestrally with no improvement. The overall objective was to determine the performance potential of native potato ulluco (ulluco), oca and mashwa through assessment of the behavior of eight varieties under optimal environment conditions in the village of Candelaria, province of Chapare in the department Cochabamba.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

In Cochabamba, three micro-centerss of biodiversity of Andean tuber were identified: Candelaria (Colomi, Chapare Province), Pocanche - Chuchuani (Independence, Prov Ayopaya) and Laimetoro (Totora, Prov Carrasco). In these centers factors influencing the management of Andean tubers in farmers' fields were identified, including production objectives, introduction of new varieties and consumption patterns of rural families. Family seedlots were evaluated in order to determine the diversity of native potato cultivated in Candelaria. The unit of analysis is the farmer's field, considered as an agro-ecosystem in which potential and threats are identified as well as the relationship with the surrounding environment (market, traders, agro-industry, municipalities, etc.).

3. PROYECTO INTEGRAL ALTIPLANO

Country: Bolivia/Peru

Organization: INIAP, CIP, IPGRI, SDC

Budget: Total cost of the Collaborative Programme US$ 9.6 million in 10 years

DESCRIPTION OF THE INTERVENTION

The main objective of the project was to enhance the mechanisms of conservation and use of the biodiversity of Andean tubers in the family system of farmers in the Bolivian-Peruvian altiplano, tracking the flow of seed of RTAs from farmplots to their final destination and documenting their relationship to traditional fairs, management strategies, Andean worldview and use in rural diets.

The project is developed around three lines of action:

1. Identification of the dynamics of conservation of Andean tubers in Yunguyo, Puno (Peru)
2. Production of high quality seed of Andean tubers, return and control in their areas of origin. Copacabana - Escoma (Bolivia)
3. Conservation and use of Andean roots and tuber in the region kallawayas (Bolivia)

Specific objectives:

- Returning native genetic materials to their home areas after cleaning them from viral threats
- Understanding the dynamics of conservation micro-centerss' dynamics through the inventory of varieties, the seed flow and its relationship with the market (fairs) and the implementation of participatory workshops on conservation
- Promoting consumption of Andean tubers and other local products to improve the nutrition of children (mainly 0-2 years, who are the most vulnerable in these areas).

Activities:

1. Identification of the dynamics of conservation of Andean tubers through research on crops and fairs
2. Production of high quality seed of Andean tubers, return and control in their areas of origin through selection techniques and marketing of high quality seeds
3. Conservation and use of Andean roots and tubers in the region through studies, training and improved uses

RATIONALE OF THE INTERVENTION

The project was carried out within the Peruvian-Bolivian Altiplano, in the plateau area around Lake Titicaca (8,200 km2). In both countries Andean genetic resources are preserved and used almost exclusively by peasant families. Informal relationships help protect, maintain and use agro-biodiversity. Quechua and Aymara indigenous people reside in the area, sharing a common past and similar production systems.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Before the intervention, an inventory of agrobiodiversity in the area was undertaken. In both countries the potato is the main crop and occupies the largest area of planting, followed in order of importance by barley, quinoa, Andean tubers and beans. Native species have high genetic variability, planted in the form of varietal mixtures in the same plot. Families are smallholders and have several plots (100 to 2,000 m²) located in

different areas of the same community or elsewhere. Farmers keep plots cultivated with many varieties along with other plots left to rest and used for grazing.

4. PROMOCIÓN DE CULTIVOS ANDINOS: DESARROLLO DE AGROINDUSTRIAS Y MERCADOS PARA LA ARRACACHA

Country: Bolivia, Ecuador, Peru
Organization: Consorcio para el Desarrollo Sostenible de la Ecorregión Andina (CONDESAN), SDC, IDRC-Canada
Budget: US$ 267,000

DESCRIPTION OF THE INTERVENTION

The aim of the program is to improve the quality of life of rural Andean families, achieving competitive production of roots and tubers through the conservation and efficient use of biodiversity.

Specific Objectives:

1. To synthesize and generate a methodology for developing valid traditional agro-industries in the Andes
2. To identify pilot areas agribusiness CONDESAN where promising traditional activities can be strengthened
3. To strengthen the institutional capacities of partners at the Andean countries in technical and social aspects related to agribusiness development.
4. At regional/ local level:
5. To improve the competitiveness of Arracacha's various products
6. To strengthen local capacity through training leader peasants.

Activities:

1. Increasing agricultural production in micro-centers through improved technologies and market strategies (training, manuals)
2. Local capacity strengthening through manuals and formation of leaders
3. Promotion and diffusion of Andean roots through market niches

RATIONALE OF THE INTERVENTION

Arracacha is a root of regional importance, the promotion of which could help alleviate poverty and generate local development processes for the benefit of Andean families. This hypothesis is supported by the growing demand of this root for its easy adaptability to different ecological areas, and for the degree of interest shown in the industry, and because it is associated with a fine and delicate product.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Microcentres with great diversity and productive potential were selected, as well as promising products, with priority to the Arracacha (Arracacia xanthorriza). In the microcenters prioritized for project implementation in Bolivia, Peru and Ecuador, the cultivation and marketing of arracacha generates income for approximately 1,700 families representing more than 10,000 people.

Native Potato: improved production of native potatoes in the Andean highlands of Peru

Country: Peru
Organization: University of Cuzco/CRIBA, Peru, McKnight Foundation
Budget: US$ 200.000

DESCRIPTION OF THE INTERVENTION

The project, funded by McKnight Foundation and implemented from 2005 to 2009 by the Intermediate Technology Development Group (ITDG), aims to increase the food security of native Quechua and Aymara communities in the southern high Andean region of Peru (The McKnight Foundation, 2007). The project focuses on improving the production and marketing of native potato varieties by facilitating farmers to experiment and validate potato production methods combining ancestral indigenous knowledge and modern

techniques. Special emphasis is placed on the use of virus-free quality seeds, the ecological management of soil, integrated pest and disease management (ITDG, 2007).

Specific objectives:

1. To determine and disseminate the most appropriate agronomic technologies that will allow increasing the quality and productivity of native potato varieties and ecotypes identified in 12 Quechua communities in the highlands of the Province of Canchis, Cusco
2. To establish local sustainable systems for the provision of seed and technical assistance that will allow increasing the quality and yield of native potato crops for the small-scale producers of 12 highland Quechua communities in the Province of Canchis, Cusco
3. To lay the foundations for the native potato market growth in the country, identifying market opportunities, testing models that will allow an adequate commercialization and disseminate the results obtained

Activities:

1. Exchange of seeds through agreements within farmers
2. Virus cleaning and delivering virus-free native potato varieties from CIP's Germ-plasm Bank
3. Distribution of healthy native potato seeds to families for sowing and multiplying
4. Participatory studies on traditional knowledge and uses
5. Training events such as Farmers' Field School workshops
6. Community workshops and field trips
7. Promotion of native potatoes through media diffusion.

RATIONALE OF THE INTERVENTION

Environmental conditions are extremely hostile in the high Andes, and farmers are subjected to periodic droughts, cold spells, and floods. In Peru, the 170,000 families living in the high Andes are the most poverty-stricken people in the country. Native potatoes have a number of advantages over commercial varieties, including excellent culinary qualities, good flavor, a low water and sugar content, and high content of dry matter, proteins, and minerals. Native potato varieties that are adapted to these conditions are currently in danger of being lost.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Technical development and scientific research on native potatoes are surprisingly underdeveloped in the Andean region, even though the cultivation of potatoes originated there over 10,000 years ago. Native potatoes have a number of advantages over commercial varieties, including excellent culinary qualities, good flavor, a low water and sugar content, and high content of dry matter, proteins, and minerals. They are easy to cook, fry, and process; and people are willing to pay higher prices for them. But yields are low as a result of some problems that need to be addressed, including virus infection and susceptibility to pests and diseases.

Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands

Country: Peru

Organization: University of Cuzco/CRIBA, Peru, McKnight Foundation

Budget: US$ 872,000

DESCRIPTION OF THE INTERVENTION

Funded by the McKnight Foundation and implemented by the University of Cuzco/CRIBA, the project has been running from 1995 to 1999 and was renewed for a second phase from 2001 to 2005. The aim is to improve the biodiversity of Andean tubers by applying sustainable practices, documenting traditional knowledge and uses, and translating it into a larger scale (The McKnight Foundation, 2006). Combining biology, agronomy, and

social sciences, this project worked with farmers from six villages to understand how they traditionally have conserved genetic resources through their cropping systems and to help them manage the weevil pests. The researchers developed a system of integrated pest management, studied the genetic diversity of the tubers, and worked with conventional and marker-assisted breeding methods to improve the nutritional content, storage, and marketing of the tubers.

Specific objectives:

1. To strengthen the factors which contribute to a sustainable conservation and utilization of oca, ulluco, mashwa and Andean potatoes without damaging environment.
2. To develop strategies for integrated management of oca, ulluco, and Andean potato weevils as one system.

Activities:

1. Documenting the cultivars/morphotypes grown by farmers and their geographical distribution
2. Documenting farmers' knowledge of Andean tubers
3. Post harvest and storage technology improvement
4. Identifying barriers to marketing
5. Diffusion of knowledge and training to promote agro-biodiversity conservation and food security
6. Training on methods of integrated crop and weevils management

RATIONALE OF THE INTERVENTION

In the Andean highlands, subsistence farmers grow a variety of tuber crops that produce income and provide daily nourishment. In some rural communities during the harvest season, these tubers can account for up to 90 percent of the diet. Although generally productive in the marginal Andean soils, the crops — oca, ulluco, and potato — are vulnerable to insect pests, particularly weevils. Weevils and other problems, including weather conditions, low yields caused by soil erosion and nutrient loss, population pressures, and market isolation, have been diminishing the plants' biodiversity.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Morphotypes of Andean tubers were identified out of 2,526 studied in the rural communities of Picol, Matinga, Qqueccayoq, P'oques, Chumpi, and Sayllafaya. Farmers' knowledge for tuber seed handling, planting, weather forecast, field management, and communal organization have been documented. Four markets, local fairs, and inter-communal ones have been identified as important markets to sell/purchase Andean tubers.

Uso, manejo y conservación *in situ* de tres variedades locales de papa en el Austro Ecuatoriano

Country: Ecuador

Organization: PROCAM, UNDP, Centro de Desarrollo e Investigación Rural CEDIR

Budget: US$ 60,000

DESCRIPTION OF THE INTERVENTION

This UNDP funded project was conducted by Centro de Desarrollo e Investigación Rural (CEDIR) in five communities located in Ludo base, Octavio Cordero, Tambo and Canar (Pinguil et al., 2006). The project's objective was to support small and medium farmers of Azuay and Canar in the conservation of potato diversity to evaluate its multipurpose in terms of the household food security and promoting its commercial dissemination (UNDP, 2000).

Activities:

1. Forming, training, organizing and promoting conservationists groups on seed management and local biodiversity
2. Collecting at least 30 varieties of local potatoes
3. Implement crop germ-plasm plots in Azuay, Canar, characterization and multiplication
4. Demonstration field days for potential users of local seeds

5. Workshops to promote management and conservation of local seeds
6. Technical monitoring of cultivation techniques and demonstration of conservation and production practices
7. Installing demonstration plots in areas with a potential for the use of potato seeds
8. Marketing: transformed products were marketed under the name "Es Vida" (It's Life)

RATIONALE OF THE INTERVENTION

The provinces of Azuay, El Oro and Loja are rich in biodiversity but face serious problems of deterioration and diversity loss. Loja and Azuay are respectively the fourth and fifth province of the country by number of endemic species of plants, which are little know. These provinces are also affected by severe desertification processes and face a critical social situation, because of the incidence of poverty and migration to other wealthier regions.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

The background for this project is a 7 year research process on native potato varieties, followed by a phase of seed multiplication to deliver material to local populations.

Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi, provincia Chapare – Cochabamba

Country: Bolivia
Organization: PROINPA Foundation, Fundación PUMA, Iniciativa para las Américas (EIA)
Budget: US$ 86,000

DESCRIPTION OF THE INTERVENTION

The project falls within the framework of the plan for the sustainable use of biodiversity of Andean roots in the subtropics of Cochabamba and is operated by members of the community of Colomi, which include women and youth who were trained in various stages of the process and supported by a group of entities (GPA, 2005). Objective of the project was to conserve species and varieties of Andean roots originating in the subtropical area of Colomi, in the department of Cochabamba. Secondarily the project aimed to strengthen Andean root production, respecting the environment and applying organic farming in indigenous communities.

One of the results of this project has been the recovery of seed production, and its reallocation between different communities (Nuñez, 2008). Currently the communities manage and use eight varieties of arracacha, four of leafcup, three of achira and one of ajipa, thus ensuring the preservation and enhancement of valuable genetic resources. Activities have been conducted with the technical assistance and facilitation of PROINPA Foundation and the active participation of producers and members of the Asociación de Productores y Procesadores ecológicos de Agrobiodiversidad (APyPA) - previously ACEPLO- subtropical zone Colomi. The project started in August 2005 for a period of 18 months, but was implemented until 2008, reformulated in track by PUMA Foundation, and finalized with the construction of the Processing Plant of Andean Roots. To make sure that the plant would be operated by the community, women farmers were trained and are responsible for producing the dried leafcup, achira and arracacha flour, and arracacha, achira and ajipa starch.

Activities:

1. Organization and administration of the project in the first year.
2. Agro-ecological production plan developed, agreed and approved in the first year
3. ACEPLO partners community members trained through FFS since 2005.
4. Andean roots organically grown by ACEPLO partners since 2005.
5. Products processed locally at the processing plant since 2006
6. Andean roots and their derivatives certified as organic products from 2008.
7. Promotion and marketing of Andean roots from the second year.

RATIONALE OF THE INTERVENTION

The production and commercialization of Andean roots would improve the quality of life of 200 families, including members of the Association of Organic Producers and Processors of Agro-biodiversity in the 10 communities where it operates.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

N/A

Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica, Peru

Country: Peru
Organization: CIP, INIAP, FEMUCAY, MCKNIGHT
Budget: US$ 800.000

DESCRIPTION OF THE INTERVENTION

The project, funded by The McKnight Foundation, was executed by the Yanapai Group from 2005 to 2009 with the cooperation of the International Potato Center-CIP, the National Institute for Agricultural Research-INIA Huancayo, the Chopccas Communities formed by 13 Populated Centers and 3 annex and Chopcca Sub-basin Women's Organizations that belong to the Yauli-FEMUCAY Peasant Women Federation (The McKnight Foundation, 2006b) The aim of the project is to improve agricultural productivity by fostering Andean biodiversity as an exercise of rights and as a strategy for the sustainable development in the Chopcca communities of the Huancavelica region.

Specific objectives:

1. To recover agro-biodiversity, with an emphasis on potatoes, with the purpose of improving the management of crop and pasture areas, and improve the productivity and the diet of the families
2. To implement integrated management practices for the main pests and diseases of the crops, with an emphasis on potatoes and andean tubers
3. To improve the conservation of soil fertility through modern and traditional techniques that optimize the use of local resources
4. To strengthen the capacities, skills and proficiencies of the families in terms of generating alternatives which combine local practices and technological innovations for the improvement of production systems
5. To facilitate experience exchange, mutual support and collective learning in the Andean Region and Communities of the Peruvian Andes

Activities:

1. Collection and Characterization of the diversity of Andean tubers
2. Recovery of natural pastures
3. Selection of adapted Andean crops from the material of INIEA (Instituto Nacional de Investigación y Extensión Agraria)
4. Introduction of new lines of blight and frost resistant barley. New lines of botrytis resistant, high yielding broad beans, will be selected by the farmers
5. Integrated pest management
6. Research on the use of vegetable and mineral extracts in the management of pests for the main crops of the Chopcca communities
7. Implementation of two Farmer Field Schools in Integrated Livestock Management
8. Study on soil quality in the chopcca community
9. Strengthening of the Women and Community Board of Directors

RATIONALE OF THE INTERVENTION

The Chopcca community consists of 16 population centers located at or above 3,600 meters above sea level, with 3,451 registered community members and a population of approximately 8,000 units distributed between the districts of Yauli in Huancavelica and Paucará in Acobamb province. The Huancavelica Region is the poorest

department in Peru, with 84% of the people living in poverty and 62% categorized as extremely poor. The main sources of livelihood for these isolated communities are subsistence agriculture and animal husbandry (mainly sheep). Soil degradation is the most critical problem in the area. Crops and pastures have become less productive as traditional land management techniques have been lost and population increases have led to intensification of land use. Farmland is being degraded by erosion and crops are increasingly vulnerable to pests and diseases. Research and development agencies are absent from the area

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

The Yanapai Group uses Participatory Research Action that involves the farmers in the "research–action" process, generating a horizontal, mutually trusting, relationship with them. In order to present the project to the Chopcca communities, three meetings were held with the Chopcca board of directors, in order to explain the objectives and scope of the project, and in order to prepare a common work agenda with them.

Potato moth. Biopesticide development and diffusion of potato moths

Country: Ecuador

Organization: PUCE, IRD, INIAP, MCKNIGHT FOUNDATION

Budget: N/A

DESCRIPTION OF THE INTERVENTION

This McKnight project focuses on the development of a biopesticide and the training of farmers in potato moth integrated management (Onore et al., 2006). The goal of the project is to develop an integrated management strategy of the potato moth (Tecia solanivora and Symmetrischema tangolias), including a viral pesticide that is economic, efficient and easy to apply by farmers, and make it available to potato farmers and technicians. Secondarily, the project aims at training farmers in integrated pest management.

Specific objectives:

1. Development of the Bio-plaguicide
2. Distribution mapping and dynamics.
3. Technology transfer
4. Inter- institutional Coordination

Activities:

5. Collection of biological material; multiplication and characterization of viruses; optimization of the mass production of the virus; laboratory bio-trials; viral bio-plaguicide evaluations
6. Mapping; predators and/or parasitoids collection, potato moth's natural enemies
7. Establishment of the baseline and work plan; preparation of didactic material; training of trainers

RATIONALE OF THE INTERVENTION

The potato is central to the culture and diet of Andean people and is fourth among the world's principle food crops. Andean potato production is threatened by an emerging pest known as the Guatemalan potato moth (Tecia solanivora; Lepidoptera, Gelechiidae), whose larvae destroy potato tubers. T. solanivora is the most serious pest of potato in Central America, where the insect originated, and it has moved to South America through the potato trade. It has become one of the gravest problems facing potato producers in Ecuador and it also poses a serious threat to potato producers in other countries in the region.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

The project studied the population dynamics of T. solanivora, Symmetrichema tangolias and Phthorimaea operculell pests, mapped their distribution in Carchi, Chimborazo and other provinces, and tried to identify natural enemies (predators and parasitoids) of potential importance.

ANDEAN GRAINS

Andean grains are important for their high nutritional content, which is quality proteins and rich micronutrient profile, but also for their hardiness in different agro-ecological zones, their good adaptability to environmental stresses and versatility in use. They are also strongly connected to the food culture and traditions of Andean people, persistent, widespread and appreciated by local civilizations over millennia. Among these grains, Quinoa, a grain-like crop whose seeds are highly nutritive due to an exceptional protein and mineral quality, of which cereals are short, is very important in Andean culture. It is a resistant and adaptable crop, drought but also frost resistant (Jakobsen, 2000). Bolivia is the biggest producer of quinoa, with 46% of world production, followed by Peru with 42%, but training and technical assistance are necessary in order to introduce the technological changes required to improve the crops' productivity and competitiveness. *In situ* conservation studies have only started in 2001-2002 to complement the existent *ex situ* strategies. Another valuable grain is the Cañihua, which originated in the Andes of southern Peru and Bolivia and is especially important for human consumption in high plateaus between 3,800 and 4,300 m because of its resistance to cold (Bermejo and León, 1994). All three native grains (cañihua, quinoa, love-lies-bleeding or kiwicha) are highly tolerant of marginal conditions. Caniwa and quinoa are adapted to cold and drought; kiwicha to drought. They are in fact cultivated in the rarefied elevations of the Andean snow line where few crops can survive, their cultivation going back thousands of years.

However, the competition of commodity cereal crops such as wheat and barley is the main reason for their marginalization in spite of their role as staple foods. Moreover, the lack of improved varieties or enhanced cultivation and processing practices, low added value, disorganized or non-existent market chains added to a misperception of these grains as 'poor man crops' have contributed to their falling out (Rojas et al., 2009). Most of the limitations to the widespread use of Andean grains are due to the low distribution of their cultivation. The difficulty of harvesting as a consequence of non-uniform grain ripening is currently one of the main constraints. Furthermore, outside of their production areas, little is known about the use of this species for food and consumption limited to producers.

Chenopodium Pallidicaule

Cañihua: this Andean grain has high protein content and, like quinoa and love-lies-bleeding (kiwicha), a high proportion of sulphur-containing amino acids. It also has the advantage of not containing saponins, which facilitates its use. Cañihua is traditionally consumed in the form of lightly roasted, ground grains which produce a flour called cañihuaco. This is consumed on its own, in cold or hot drinks, or in porridges. Its cultivation has been restricted to some areas of the highlands of La Paz and Cochabamba, because of the plant resistance to low temperatures. However, the large number of people required to harvest it and its small grain size, which makes handling difficult, are among the causes of its marginalization. At present, its cultivation and utilization are maintained at subsistence levels.

Chenopodium Quinoa

Quinoa: the content and quality of quinua's proteins are outstanding because of their essential amino acid composition (lysine, arginine, histidine and methionine); its biological value is comparable to milk and it is especially suitable for food mixtures with legumes and cereals. Its particular hardiness allows generating good yields in also semiarid and arid places. These outstanding properties make it a highly valuable crop for nutrition and food security of the Andean populations. In spite of these properties, its marginalization began with the introduction of cereals such as barley tnd wheat, for some technical, economic and social reasons. Traditional practices of harvesting and threshing, done by hand, take many days and the grain requires a process to remove its bitter ingredients before consumption. Another limiting factor influencing productivity, are pests that attack the crop in different phenological phases. Production costs are therefore high for producers, a problem that could be overcome with the development of appropriate technologies.

Amaranthus Caudatus

Love-Lies-Bleeding (Amaranto - Kiwicha): thank to its excellent nutritional content, kiwicha is quite persistent among farmers. It is high in proteins (12 to 16 percent), and its amino acid composition is well balanced and higher than in other cereals. It does not contain saponins or alkaloids and the leaves are edible. Efficient at fixing carbon dioxide, it requires less water to produce the same amount of biomass as cereals. Kiwicha can be used to raise the nutritional quality of foods that are normally made from other grains such as corn, rice, or sorghum. In such blends, its food value is particularly beneficial for infants, children, and pregnant and lactating women. The advantages of lovelies-bleeding are the low cost of the unprocessed grain, the fact that it doesn't require special treatments and is easily accepted by consumers.

Enhancing the Contribution of Neglected and Underutilized Crops to Food Security and to Incomes of the Rural Poor (IFAD NUS) – Bolivia & Peru

Country: Bolivia, Peru
Organization: PROINPA Foundation, CIRNMA (Ministry of Agriculture), Bioversity International, IFAD
Budget: US$ 108.000 + 250.000 (Bolivia); US$ 96.000 + 210.000 (Peru)

DESCRIPTION OF THE INTERVENTION

The IFAD-NUS project aimed to contribute to enhance the sustainable conservation and use of neglected and underutilized species (NUS) through pilot activities in strategic areas of the World (West and South Asia, Latin America). The main goal is to contribute to raising the incomes and strengthening the food security of small farmers and rural communities around the world through securing and exploiting the full potential of the genetic diversity contained in neglected and underutilized species.
The first phase of the project was implemented between 2001 and 2003, while the second phase was carried out between 2007 and 2009.

Specific Objectives - Phase 1:

1. Provision of genetic material of the target species
2. Conservation of germplasm and associated traditional knowledge
3. Documentation of knowledge on uses, constraints and opportunities
4. Development of Community-driven actions to enhance income generation
5. Actions addressing market, commercialization and demand limitations
6. Research and development-oriented activities to strengthen national capacities
7. Establishment of effective links between conservation and crops "filierès"
8. Development of policy and legal frameworks and public awareness

Activities - Phase 1:

1. Organizations of seed fairs
2. Regeneration of accessions
3. Establishment of core collections
4. *Ex situ* conservation
5. Improvement and distribution of seeds
6. Socio economic characterization
7. Improvement of cultivation techniques
8. Training of farmers and other actors of the production chain
9. Public awareness

Specific Objectives - Phase 2:

1. Assessment and enhancement of income generation based on NUS
2. Assessment of nutritional values of NUS and development of strategies for enhanced use of NUS in nutrition programmes

3. Enhancement of human and social capital of stakeholders to manage NUS and derive benefits from their use, combined with strengthening of local identity
4. Exploring the role of rural tourism in promoting NUS
5. Improvement of availability, knowledge and maintenance of genetic resource base
6. Promotion of better policies and legal frameworks for the sustainable and equitable use of NUS
7. Promoting cooperation in NUS management and raising awareness of the importance of NUS to livelihoods
8. Mobilization of support and raising funds for NUS activities

Activities - Phase 2:

1. Assessment of the competitiveness of NUS
2. Assessment of nutritional values of NUS and their potential impact
3. Capacity building initiatives
4. Establishment of value addition strategies
5. Establishment of farmers' associations
6. Activities to empower women
7. Community based initiatives to raise self-esteem
8. Activities to raise awareness of role of NUS in peoples' livelihoods
9. Activities to understand and promote rural tourism in the maintenance of diversity
10. Activities to improve availability of germplasm, maintain indigenous knowledge, and strengthen seed production systems
11. Solutions to improve policy and legal frameworks
12. Activities to raise public awareness among policy makers
13. Activities to raise awareness of the economic, social, nutritional and cultural importance of NUS
14. Enhancement of supply/value chain of target species
15. Activities to mobilize political support and raise funds in support of NUS

RATIONALE OF THE INTERVENTION

Despite their name, neglected and underutilized species (NUS) provide the rural and urban poor with important income opportunities and nutritional benefits. They provide relevant contributions to dietary diversity, help to remedy nutritional deficiencies, are successful crops in marginal areas, often require low agricultural inputs, and have largely untapped economic potential. Enhancing the use of NUS, which are often key livelihood assets of the rural poor, leads to improved incomes and well-being of the poor and marginalized

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Targeted species have been selected during ad hoc Stakeholders participatory meetings held during preparatory phase at national and regional level.

Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA

Country: Bolivia

Organization: PROINPA Foundation, Ministerio de Desarrollo Rural, Agropecuario y Medio Ambiente - Sistema Boliviano de Tecnología Agropecuaria (SIBTA)

Budget: N/A

DESCRIPTION OF THE INTERVENTION

The project was executed between 2003 and 2008 by the Subsistema de Granos Altoandinos (High Andean Grain Subsystem) of the National System of Genetic Resources for Food and Agriculture (SINARGEA), which depends from the Ministry of Rural Development, Agriculture and Environment (MDRAyMA). The PROINPA Foundation is the leading institution of the Subsistema de Granos Altoandinos and has among its responsibilities the management and conservation of the National Germplasm Bank of High Andean Grain

(BNGA). Work Collections are in charge of the Universidad Mayor de San Andrés - UMSA, the Technical University of Oruro - UTO and the Center for Community-Based Research and Production Irpani - CIPROCOM. Objective of the project was to ensure the conservation of High Andean Grain germplasm and increase its usability through a coordinated effort between the Active Germplasm Bank of the Subsystem, the Work Collections and other strategic alliances.

Specific Objectives:

1. National Germplasm Bank of High Andean Grain: adequately manage and conserve germplasm collections preserved in the National High Andean Grain Bank; study the germplasm collections using molecular techniques; increase the use of genetic resources of Andean grains under the SINARGEAA strategy; promote the genetic diversity of Andean grains and strengthen the capabilities of the Subsystem.
2. Relationship with the conservation *in situ*: to strengthen research and monitor *in situ* conservation of the genetic resources of Andean grains in microcentres of diversity
3. Work Collections: promote the local use and conservation of genetic resources of Andean grains through participatory assessments.

Activities:

1. Characterization and evaluation of germplasm collections, regeneration and multiplication
2. Consolidation of storage systems
3. Diversity fairs; identification of diversity microcentres; inventories and characterizaiton of agrobiodiversity
4. Visits to the National Germplasm Bank High Andean Grain (BNGA); establishment of community banks
5. Participatory assessments; follow-up on family farms
6. Agrobiodiversity Contests
7. Exchange of experience and traditional knowledge
8. Genetic improvement; seed distribution; selection of cañahua accessions with forage potential
9. Market links
10. Participation in fairs for the promotion and dissemination of information; promotion on radio and television programs; publications
11. Staff and farmers training

RATIONALE OF THE INTERVENTION

The intervention develops from the need for the National Germplasm Bank to give continuity to the activities for the conservation and consolidation of germplasm of High Andean Grains through different methodologies and increasing the usability of the accessions.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

N/A

Desarrollo Sostenible de Quinua Orgánica en el Perú

Country: Peru

Organization: Instituto Nacional de Investigación y Extensión Agraria (INIEA), Scanagri/NIRAS

Budget: N/A

DESCRIPTION OF THE INTERVENTION

The general objective is to improve the production and marketing systems of quinoa with the aim of contributing to the security of food supply, income generation and environmental preservation in the Andean region.

Specific objective:

1. Develop technology for organic production by improving control of biotic and abiotic adverse factors in order to foster sustainability in agro-ecosystems of the Andean region.

2. Conduct an investigation of actual and potential markets for organic and conventional Quinoa nationally and internationally.

Activities:

1. Activities to control q'hona q'hona
2. Study and application of organic fertilizer
3. Organization and training of farmers
4. Creation of associations
5. Analysis of national and international market
6. Business Plan preparation

RATIONALE OF THE INTERVENTION

There are few doubts that increased trade liberalization has reduced the capacity of countries to promote food production within their own borders. In South America this has caused the reduction in the production of quinoa in the past five decades, since the increase in imports of subsidized wheat products in North America has shifted to traditional crops and foods produced domestically. To address the problems faced by farmers and for a sustainable strategy for organic production of quinoa in the Andes the project worked to develop a technology for organic production, to promote use and consumption of quinoa nationally and internationally and to develop market oriented organizations.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

During the inception workshop project activities were planned, production processing and marketing problems defined, prioritized and possible solutions presented.

Sustainable production of quinoa: a neglected food crop in the Andean region

Country: Bolivia
Organization: PROINPA, McKnight Foundation
Budget: N/A

DESCRIPTION OF THE INTERVENTION

This McKnight financed project is a partnership between the PROINPA Foundation in Bolivia and Brigham Young University in the United States. The project ran from 2001 to 2005 (first phase) and from 2006 to 2010 with the aim of holistically improving quinoa production, utilization and marketing in the Andean region. The area of intervention is in communities around the Salar de Uyuni salt desert, in the Potosi and Oruro departments. The objective of the project is to use an integrated, multidisciplinary approach to increase quinoa production, consumption, and marketing in the Bolivian Altiplano as a mean for strengthening food security.

Specific objectives:

1. To implement a strategy for the *ex situ* and *in situ* conservation of quinoa genetic resources.
2. To establish a breeding and genetic improvement program for quinoa, utilizing modern tools of breeding and biotechnology.
3. Develop components for sustainable production and marketing of quinoa.
4. Improve extension programs with the aim of capacity building of rural people to develop economic and nutritional self-sufficiency.

Activities:

1. Morphological characterization and geographic distribution of the quinoa collection
2. Evaluation of the nutritional value of accessions in the quinoa core collection
3. Role for women in the adoption of technology and decision-making in quinoa conservation in the Southern Altiplano
4. Genetic improvement, seed production and distribution of varieties
5. Strategic development of a program for breeding, maintaining and distributing improved varieties

6. Release of new varieties
7. Distribution of improved quinoa varieties in the Central and Northern Altiplano
8. Incorporation of three species as green manure and determination of their effects on grain yield for different quinoa varieties
9. Training and distribution of information

RATIONALE OF THE INTERVENTION

The food security of rural inhabitants in this part of South America is tenuous because most are subsistence farmer families with small land holdings. Quinoa is a major staple food and cash crop for subsistence farming families in this region. It is remarkably well-adapted to the harsh environmental conditions of the Altiplano, which can include aridity, salinity and frequent frosts. In some areas, it is the only crop that can be cultivated. Quinoa is also well known for its superior nutritional properties, its protein content and ideal balance of essential amino acids. However, many farmers are unable to produce sufficient quinoa to meet their nutritional needs.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

For the projects' purpose agronomic and morphological information generated during four different growing seasons in the 1990s for 59 quantitative and qualitative characters were obtained. Through analysis of the quinoa germ-plasm collection, geographic subcenters for genetic variation in the country were identified. One of them is the southern Altiplano, a region where ecotypes of Quinoa Real are produced, and where the greatest variability for exported, large-seeded quinoa is found. A study was conducted on the geographic distribution of the quinoa collection, financed by SIBTA, with the objective of identifying the areas of greatest variability for quinoa in the southern Altiplano.

Lupin/quinoa: sustainable production systems to guarantee food security in impoverished communities in the province of Cotopaxi, Ecuador

Country: Ecuador
Organization: National Program for Andean Legumes and Grains of the National Agricultural Research Institute (PRONALEG-GA of INIAP), McKnight Foundation
Budget: US$ 240.000

DESCRIPTION OF THE INTERVENTION

From 2005 to 2009, INIAP and the Social Development Committee “Path To Progress” (CODESOCP) developed this project with the objective of alleviating the levels of poverty and malnutrition in the Province of Cotopaxi through the improvement of quinoa and lupin production systems. To achieve this outcome, strategic alliances and participative research have been strengthened, with a focus on gender and agro-ecology. The project has been implemented in the communities of Ninín Cachipata, Chaluapamba, Chilla Chico and Canchagua of the Saquisilí Canton.
Specific objectives:

1. To strengthen the production systems of the Ninín Cachipata, Chaluapamba, Chilla Chico and Canchagua communities through the improvement and promotion of quinoa and lupin;
2. To evaluate and select varieties of quinoa and lupin that adapt to the edaphic-climatic conditions and are in accordance with the criteria and preferences of the farmers (men and women) of the Ninín Cachipata, Chaluapamba, Chilla Chico and Canchagua communities;
3. To identify agro-industrial applications of promising varieties and lines of quinoa and lupin;
4. To develop an informal system for the production and distribution of good quality seeds of the main crops that make up the production systems of the Ninín Cachipata, Chaluapamba, Chilla Chico and Canchagua communities;
5. To promote and diversify the consumption of Andean grains (quinoa and lupin);

6. To strengthen the agricultural research capacity of the farmers (CIALs, ECAs) and to establish links with the INIAP and other institutions to create tendencies towards the sustainable development of poor communities in Cotopaxi;
7. To give impetus to the creation of micro-enterprises to generate added value and commercialize the production of Andean grains;
8. To monitor and evaluate the progress of the project.

Activities:

1. Revaluation of farmers' know-how in production systems management
2. Research and implementation of new practices for strengthening the production systems: green manure, new crop varieties, water harvesting system
3. Quinoa and lupin lines development in greenhouses (Experimental Station) and in fields
4. Quinoa and lupin promising lines participatory evaluation through trial, verification, production and strain liberation tests
2. Bromatological analyses and development of products based on germinated, fermented and extruded quinoa
3. Development of products based on germinated, fermented and extruded quinoa
4. Development of products (milk, yogurt) from the best lines of lupin
5. Seed production trials, purification and multiplication; seed production plots, seed exchange and distribution
6. Workshops for identifying ancestral forms of consumption and for preparation of new recipes based on quinoa and lupin; study of the food system, promotion, diversification and monitoring of the quinoa and lupin home and community consumption in Ninín Cachipata, Chaluapamba, Chilla Chico and Canchagua
7. Study of the food system, promotion, diversification and monitoring of quinoa and lupin consumption at family and community levels
8. Lectures at public and private schools, radio and newspaper advertising
9. Feasibility study for two micro enterprises

RATIONALE OF THE INTERVENTION

Ecuador's on-going political, economic, and social crisis has resulted in an increase in poverty, particularly among the rural indigenous communities of the high Andes. Cotopaxi, has a high incidence of poverty (80.1%) and chronic child malnutrition (60.6%). Enhancing the production and utilization of nutritious and ecologically-beneficial Andean crops can help Ecuadorian families to improve their nutrition and livelihoods and to enhance the sustainability of their soil resources.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

The base line has been defined through a Participative Rural Diagnosis (Diagnóstico Rural Participativo – DRP) and predefined surveys. Topics such as present situation and vision of the future, institutional presence, agricultural biodiversity, identification and prioritization of the main agricultural problems and levels of well-being were covered. The bromatological and nutritional analysis of quinoa and lupin shows the high value of these foods, which could be very important for the country and the region within the strategies for food security and sovereignty.

Conservación complementaria *ex situ* - *in situ* de especies silvestres de quinoa y cañihua en Bolivia

Country: Bolivia
Organization: PROINPA Foundation, Global Environment Facility (GEF), Bioversity International
Budget: N/A

DESCRIPTION OF THE INTERVENTION

The project was funded by the United Nations Environment Programme and implemented by the Global Environment Facility between 2005 and 2009. Five countries participated to the project: Armenia, Bolivia, Madagascar, Sri Lanka and Uzbekistan. Partner organizations from these countries participate along with five international organizations dedicated to conservation: the Food and Agriculture Organization (FAO), the International Network of Botanic Gardens for Conservation (BGCI), the UNEP World Conservation Monitoring Center (WCMC), the International Union for Conservation of Nature (IUCN), and the German Federal Agency for Agriculture and Food (BLE). PROINPA Foundation is the executing agency in Bolivia.
The project aims at improving the conservation status of crop wild relatives in the genus Chenopodium through the strengthening of management information available at the National High Andean Grain Bank (BNGA) germ-plasm collections of wild cañihua and quinoa for *ex situ-in situ* conservation.
Activities (Global Plan of Action 2007):

1. Database development: the database of the bank has been widened with ecogeographic information on wild quinoa and cañihua collections
2. Taxonomic identification: 59 accessions of wild quinoa were classified into three species, also 44 accessions of wild cañahua were identified
3. Genetic variability: 57 new quinoa accessions were collected
4. Plant breeding: with the purpose of incorporating wild quinoa breeding schemes, the expansion volume and grain weight of six accessions of quinoa before and after roasting were evaluated
5. Nutritive and agroindustrial value: the nutritional assessment of quinoa accessions of 13 wild and 10 accessions of wild cañihua has been carried out. Five wild accessions of quinoa with greater grain size, high in protein, starch, and with high grain yield have been multiplied.
6. Ecological and geographic information on wild quinoa was collected in the departments of Cochabamba, Chuquisaca and Potosí. Threatened species were categorized in the Red Book of Crop Wild Relatives. Technicians were trained in methods wild germ-plasm collection.
7. Promotion: two books to promote wild cañihua and quinoa were developed, radio programs were broadcasted to publicize the importance of wild relatives to the population, seminars to high school students in rural schools as well as provincial fairs were carried out.

RATIONALE OF THE INTERVENTION

The project aims to improve global food security through the effective conservation of wild relatives of cultivated species (Proyecto UNEP/GEF, 2010), which represent the ancestors of modern crops and varieties and species associated with them.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Agrobiodiversity in the three microcentres has been analyzed: 12 crops and 95 varieties in Titijoni, 12 crops and 182 varieties in Cachilaya, and 11 crops and 184 varieties Coromata. This diversity is cultivated by farmers in traditional crop management systems, with selection according to household preference.

Programa de apoyo a la cadena quinoa altiplano sur

Country: Bolivia
Organization: Fundación AUTAPO, CONACOPROQ, ANAPQUI, Prefectures and Universities of Potosi and Oruro departments, Royal Embassy of the Netherlands
Budget: N/A

DESCRIPTION OF THE INTERVENTION

The Programa de Apoyo a la Cadena Quinua Altiplano Sur has been implemented by FAUTAPO Foundation from 2005 to 2008 under the "Plan to Strengthen Quinoa Chain", with the objective of positioning Bolivia as a leader and major supplier of organic quinoa in the international market (Fundaciòn Fautapo, 2007). Measures to strengthen the quinoa production chain are developed through five components: Training, Technological Development, Promotion and export, Finance, and Coordination.

Specific objectives:

1. Funding: to increase the access to capital and credit for chain actors and improve their productivity and competitiveness
2. Capacity building: in order to adequately train actors in the production chain.
3. Technological Development: with the aim of adopting and prompting existing technologies in the quinoa chain
4. Export promotion: aimed at improving national markets and increase exports of quinoa
5. Coordination: to create a space for the coordination of practitioners in the various components of the program

Activities:

1. Soil management: soil studies, soil management plans, Incorporation of organic fertilizer (green manure)
2. Mechanization: comparative study of 4 types of plows
3. Pest control: evaluation and dissemination of light traps, assessment of biological pests control of quinoa
4. Harvesting and post harvesting practices: thresher and vent development
5. Agro-biodiversity and seeds: production of certified organic Royal Quinoa
6. Dissemination: research systematization
7. Local knowledge: revaluation of farmers' knowledge of in quinoa production

RATIONALE OF THE INTERVENTION

Quinoa is an ancient grain that grows over 3600m, surrounding the salt flat of Uyuni. The production of quinoa provides between 50% and 85% of revenues for 15000 families, most of which are poor. The program sustains the quinoa production chain and its actors, providing funding, training and legal instruments that strengthen productivity, exports and well-being of the actors involved (CABOLQUI, 2009).

DIAGNOSTIC WORK LEADING TO INTERVENTION

To identify indicators that describe the quinoa consumption behavior in the area of Potosi, statistical methods were used both for gathering information (through surveys and Interviews) as well as for the analysis of results. Soil studies have been carried out in the Southern Altiplano, showing main soil physical and chemical characteristics. Agrobiodiversity and agronomic practices in the region have been studied in order to develop appropriate management plans.

ANDEAN LEGUMES

Because Ancient common beans perform badly at high elevations, growing slowly and more difficult to cook, Andean peoples have developed their own legumes: lima bean, nuñas (a variety of the common bean (*Phaseolus vulgaris*) that pops like popcorn), and tarwi (lupin) (National Research Council, 1989). Beans are grown all through the Andes, especially in Peru, and are common among communities in remote areas. However, people in the cities hardly eat these traditional legumes any more. This explains the weak market demand for popping beans and lupines, the two most important species. Poor demand, combined with long growing cycles of seven or eight months, low yields, fungus and viral diseases endanger this agricultural heritage.

Lupinus Mutabilis

Lupin: The Andean lupin, grown since pre-Incan times, is the only American species of the genus Lupinus domesticated and cultivated as a legume (Blanco, 1982). It has great potential not only for human consumption, but also as animal feed. Its main benefit for consumption derives from its high protein content. However, it has been replaced by European crops because of the process needed to eliminate its bitter taste, for its indeterminate high content of alkaloids and its consumption limited to the indigenous

population. Lupin is one of the native Andean species most affected by marginalization despite its agronomic and nutritional benefits such as the fixing of atmospheric nitrogen, cold resistance and a high protein and oil content. The grain has a high alkaloid content which imparts a very bitter taste and a process is therefore needed to eliminate it, thus giving it a disadvantage compared with other introduced legumes. The result has been a reduction in cultivated area of *L. mutabilis*, despite its agronomic and nutritional benefits such as the fixing of atmospheric nitrogen (more than 100 kg per hectare), cold resistance and a high protein and oil content. The Andean lupin is not only an important source of protein (42.2 percent in the dry grain, 20 percent in the cooked grain and 44.5 percent in the flour), but also of fat which in the dry grain is 16 percent and in the flour 23 percent. It is used for human consumption after the bitter taste has been removed, a process for which there are several methods. Preparation varies according to the region and the occasion on which it is eaten: cebiche serrano, soups (cream of Andean lupin); stews *(pipián,* a kind of fricassee); desserts (mazamorra custard with orange) and soft drinks (papaya juice with Andean lupin flour). There is potential in the increased use of this crop: for instance, maize crop rotations could be improved by a more frequent presence of legumes. However, improved agronomic practices, especially in planting density and better pest management are necessary.

Phaseolus Vulgaris

Nuñas (Popping Beans): this species is cultivated from northern Ecuador to northern Bolivia, mainly in the northern Peruvian Andes, particularly in the departments of Cajamarca and La Libertad. Agricultural techniques are the same as those used with common beans. In the Andes, it is almost always planted with corn to let it climb up its stalks. In the northern and central Peruvian Andes the nuñas are prepared as the popcorn. Nutrient levels are similar to those of beans and the protein content is around 22%. Its yields can be erratic and compared with other bean varieties, it is relatively susceptible to pests and diseases.

Green manure and legumes: integrating agronomic and health research for improving the production of food and diets in marginal areas of Northern Potosi

Country: Bolivia
Organization: World Neighbors, McKnight Foundation
Budget: N/A

DESCRIPTION OF THE INTERVENTION

The project was implemented by World Neighbors from 2005 to 2009, addressing three problems: high levels of extreme poverty, food insecurity and malnutrition; declining soil fertility and agricultural productivity; and lack of institutional mechanisms and support for farmers (The McKnight Foundation, 2008). The areas of implementation are the Municipalities of San Pedro de Buena Vista, Sacaca and Acasio in Northern Potosí, Bolivia. The aim of the project was to educate marginalized communities to improve food security through research in the cultivation of legumes that increase crop yield, the soil's capacity of regeneration, access to and availability of highly nutritious quality foods.

Specific objectives:

1. To train local participants in identifying opportunities of green manure, forage, and legume grains in crop rotation, to obtain a positive impact on soil health and the families' productive capacity.
2. To build local capacity of agricultural innovation that enhances soil health and contributes to more sustainable and productive food systems through strengthening of community-based organizations.
3. To improve maternal and child nutrition with activities that build on gains in crop productivity from participatory research on legumes in crop rotation.

Activities:

1. Participatory analysis of cultivation systems in three areas of varying elevation to define the candidate germ-plasm for community trials, the basis for community sustainability and the type of evaluations to be adopted
2. Participatory trials with legumes (lima beans, common beans, peas and lupin), forage, and green manures/live barriers; trials in plant pots and greenhouses with promising species to determine their impact on soil health
3. Analysis of the sustainability of existing and new practices through a budget and an economic analysis of the soil's nutrients
4. Three community and organizational exchanges each year; training through work-shops and participatory field trials on design, soil health and breeding concepts, seed production, forage, green manure and soil conservation strategies.
5. Participation in coordination meetings to strengthen local initiatives to promote food security
6. Participatory capacity building for women's groups on food use and forage crops; women groups' training on monitoring the nutritional state of pregnant women and children, and addressing malnutrition through strengthening of existing practices

RATIONALE OF THE INTERVENTION

Northern Potosí is one of the poorest parts of Bolivia. The increased use of legume crops offers a set of potential benefits including improved agricultural productivity and sustainability, better income and livelihoods, and improved nutrition. Legumes contribute to soil fertility through biological nitrogen fixation and erosion prevention. In association with cereal and forage grasses, legumes can provide both these benefits in the form of green manure/cover crops, live barriers, managed fallows using forages, and greater use of grain legumes in the crop rotation. Furthermore, legume forages can improve animal productivity, and legume grains commonly contain high quality fat and protein for improving human nutrition and health.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Preliminary meetings were held in the communities with the participation of key leaders and community members, with the objective of informing and preparing a tentative pledge plan. A nutritional diagnosis was also carried out in the communities through the execution of the baseline in the areas of San Pedro, Toracarí, Sakani, Kisivillque and Chiroq'asa between October and November 2005, collecting data of 50 communities: 25 intervention communities and 25 witness communities at five different altitude levels, employing anthropometrical, food frequency and 24-hour recollection instruments.

Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)

Country: Ecuador
Organization: PROINPA, McKnight Foundation
Budget: N/A

DESCRIPTION OF THE INTERVENTION

The project, financed by McKnight Foundation, has been executed by the Network for Community Management of Natural Resources (MACRENA), the Consulting Committee (World Neighbors –Andean Region, CIDICCO Honduras and the "Pontifica Universidad Católica del Ecuador Sede Ibarra"), and the cooperating agencies AGRECO, UNORCAC and CUC. The project aimed at increasing food security through appropriate and sustainable approaches to improve soil fertility, identify and characterize existing knowledge and practices, evaluate most effective and sustainable approaches to cover agriculture, and dissemination (MACRENA, 2006). The area of intervention is the Chota Valley in Imbabura province.
Specific objectives:

1. To enable rural families in the highland Andes in Ecuador to improve their food security through appropriate and sustainable approaches to improving soil fertility, and to share these approaches to organizations and communities
2. To identify and characterize knowledge and practices related to existing farming and soil management systems, as well as factors that contribute to or constrain the development of appropriate cover agriculture for soil conservation and improvement.
3. To design and test management and technological innovations in order to identify the most effective and sustainable approaches of cover agriculture.
4. To produce media and processes for effective documentation, analysis, and exchange of knowledge and experiences among rural stakeholders.

Activities:

1. Methodology and instruments for systems inventory, socioeconomic analyses and farmer experiments designed by local organizations, the coordination committee and the technical
2. Field research on cover agriculture systems in the Ecuadorian Andes
3. Collection of data for the participative socioeconomic analysis
4. Analysis and publication of information on knowledge gaps and structural obstacles of socioeconomic
5. Planning meetings for defining the research priorities strategy, learning and action (thesis research and farmer experimentation)
6. A group of farmer experimenters/promoters is established in each ecological zone
7. Periodic planning, monitoring and evaluation
8. Training of farmers in participative research
9. Implementation of farmer-led research activities
10. Systematization and partial and final documentation of research

RATIONALE OF THE INTERVENTION

Soil degradation is one of the most pressing agricultural issues in the Andes, with serious consequences for the food security of impoverished rural populations. Soils are becoming less productive while populations increase, and farming families have increasing difficulty in generating adequate livelihoods. While research and practical experience has been gained with cover systems in lowland areas in the Andes, no systematic work has been done on testing these principles in the highland areas.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

A pre-diagnosis and analysis, which investigated the relationship between the proposal and the priority problems of the population, was undertaken at the beginning of the project. The next step was undertaking farmer-led experimental trials, which enabled the project participants to become familiar with cover agriculture and, having identified the productive and nutritional benefits of some of the species that were used; the farmers have begun to incorporate the techniques of cover agriculture on their farms.

WILD RELATIVES

As mentioned before, Andean crops have been domesticated for thousands of years, having evolved from species that are considered wild relatives or even ancestors. Peasants knowledge, experience, and practices, have developed from the observation and use of their surrounding environment, where wild relatives represent a pool of species from which they selected and cultivated plants that still survive, playing a fundamental part in the agroecosystems. Other than the 8 cultivated species of potatoes, 165 wild relatives of the genus Solanum are known, with over 500 species of this genus in total. Oca, Ulluco, Mashwa also have wild relatives, on which fewer studies are available. Quinoa has a close relationship with a Meso-American species, cultivated by the Aztecs known as the Chenopodium nuttaliae. The cañihua also has wild relatives often interspersed with the cultivated species. The genus Passiflora includes ornamental species as well as wild

relatives of passion fruit (Passiflora granadilla), which is the best known species, and related species such as the 'poro poro' and the 'tumbo'.

In-Situ Conservation of Native Cultivars and Their Wild Relatives - Peru

Country: Peru
Organization: INIA, Global Environment Facility (GEF), UNDP
Budget: US$ 6,720,500

DESCRIPTION OF THE INTERVENTION

The project is part of the interagency initiative between UNDP/GEF and six national institutions called Strategic Partners: ARARIWA, Centro de Servicios Agropecuarios (CESA), Comisión Coordinadora de Ciencia y Tecnología en los Andes (CCTA), Instituto de Investigaciones de la Amazonía Peruana (IIAP), Instituto Nacional de Investigación y Extensión Agraria (INIA), and the Programa Andino de Tecnologías Campesinas (PRATEC). The aim of the project is to preserve the genetic resources of native species and their wild relatives in Peru (Gutierrez et al., 2006). The project has three components: cultural diversity (grouping local people in rural communities committed to the development of agro-ecosystems to produce and use technologies compatible with traditional resource management); cooperation of public and private institutions to recover, revitalize and protect plant genetic heritage, consistently with the National Strategy on Biological Diversity; exploiting the potential of natural ecosystems and micro-watersheds in the area of work (IIAP, 2004). Activities were carried out with 892 conservationist farmers in 177 communities of twelve political regions of Peru: Ayacucho, Cajamarca, Lima, Ica, Cusco, Junín, Huancavelica, Puno, Loreto, San Martín, Piura, and Huánuco.

Specific objectives:

1. Conserving agricultural biodiversity on farm and protecting the wild relatives of native crops in surrounding areas through improved agricultural management of species and habitats.
2. Strengthening agricultural organizations and their capacity to continue on farm conservation efforts and ensuring effective participation of farmers and conservationist communities.
3. Raising awareness of the ecological, cultural and nutritious properties of native crops and their wild relatives through educational programs and key research institutions.
4. Promoting the formulation of policies, legislation and other mechanisms that encourage farmers to produce and preserve native crops and wild relatives.
5. Strengthening the introduction and development of indigenous crops and their products in local markets, nationally and internationally, ensuring that the benefits are shared equitably with conservation farmers, and marketing costs are minimized.
6. Establishing information and monitoring system that serves as a tool for planning and coordinating the activities of agro-biodiversity conservation in Peru, while ensuring a quantitative assessment based on the biological, ecological, social, cultural, political and economic impact of the project.

Activities:

1. Improvement of the management of species and habitats located on or near farms to conserve agro-biodiversity
2. Agro-biodiversity conservation on farm
3. Strengthening traditional knowledge, techniques, and organizations necessary to maintain agro-biodiversity
4. Enhancing awareness of the ecological, cultural, and nutritive values of wild relatives and native crops at educational and research institution programs on native cultivars
5. Establishing policies, norms, and incentive systems to motivate farmers to conserve agro-biodiversity
6. Strengthening incipient market for native crops at the regional and national level
7. Establishing an information and monitoring system as a management tool for coordinating and planning

RATIONALE OF THE INTERVENTION

The germ-plasm of the region is extremely valuable not only for the maintenance and improvement of Andean agro-ecosystems but also for the sustainability of plant breeding in other regions and countries. *In situ* conservation of native cultivars is aimed at strengthening and maintaining this process of farmer driven genetic adaptation by promoting the economic, policy, and institutional frameworks.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

This project is focused on 11 native crops (local varieties and wild relatives) that have originated or diversified in Peru. These were selected based on their actual or potential importance for food security, diversity within species, erosion risk, endemism, cultivated area and social and cultural importance. Specific pilot sites were identified based on analysis and prioritization of micro-centers of Andean agro-biodiversity. Existing national and sectoral policies, laws and regulations affecting land-use, agricultural development and related sectors were analyzed to determine their actual and potential effects on conservation.

NEGLECTED AND UNDERUTILIZED SPECIES

Andean Neglected and Underutilized Species include most of the crops we have analyzed so far such as arracacha, achira, leafcup, mashwa, oca, ulluco, quinoa, love-lies-bleeding, popping beans, and lupin. As already mentioned these are of great economic and nutritional importance to subsistence Andean farmers, and are often used as a substitute for expensive fruits and vegetables in the diet. Roots and tubers are especially threatened with extinction by the changing social conditions and by pressure on the environment.

Conservacion complementaria y uso sostenible de cultivos subutilizados en Ecuador. Rescate, promocion y uso de recursos fitogeneticos interandinos del Ecuador

Country: Ecuador
Organization: INIAP, UNORCAC
Budget: US$ 1,000,000

DESCRIPTION OF THE INTERVENTION

This project has been developed by UNORCAC, in coordination with INIAP, USDA, Formenos, and CORPEI, to conduct participatory research and strengthen existing on-farm conservation initiatives in combination with *ex situ* efforts, in order to increase the use of native crops in local, national and international markets. The project focuses on the inter- Andean valleys, which show great potential to better meet local production needs and generate income for producers in domestic and international markets. An interdisciplinary team of professionals from various institutions has been formed, including agronomists, growers, ethnobotanicals, economists, agroindustrial engineers, marketing specialists and teachers, among others. The team works closely with communities located in the Cotacachi canton, province of Imbabura, conducting participatory research to strengthen local initiatives on *in situ-ex situ* conservation of agro-biodiversity. The project aims to give sustainability to the conservation and management of agricultural biodiversity, as well as finding new alternative uses, contribute to food security, raise awareness among both adults and children through education in the value of these genetic resources and seek new revenues through agritourism, while retaining the cultural identity of indigenous communities.
The first phase (2002-2005) gathered information on traditional crops, while in the second phase (2006-2008) the project was implemented.
Activities:

1. Conservation of local diversity: complementary conservation of native cultivars activities aimed to rescue and conserve species *ex situ*.
2. Sustainable use of local diversity: consumption, agro-industry and marketing activities aimed at promoting the agro-industry with innovative and quality processes to enable competition in national and international markets, encouraging farmers to conserve the diversity of native crops in their fields, and increasing financial and food resources.

3. Education on agro-biodiversity: the activity was conducted with the objective of designing and implementing an environmental education program aimed at promoting agro-biodiversity conservation in the communities of the canton Cotacachi UNORCAC.
4. Agro-ecotourism: implementation of gardens of native crops in selected shelters and revival of customs and knowledge associated with them.

RATIONALE OF THE INTERVENTION

The area of Cotacachi is characterized by unequal distribution of land and unemployment. Small farms lack irrigation systems while the production is not enough to be commercialized. Water contamination, pesticides and chemical fertilizer contribute to low fertility of soils. Moreover, young people and household heads migrate to work in construction or small businesses, slowly abandoning agriculture. The project has been designed to contribute to the sustainable development of a pilot area of the inter-Andean region of Ecuador, were malnutrition affects about 40 percent of the population. The farmers in the area have received economic and technological formal support from various initiatives and institutions, but it is still insufficient to improve their productivity or to meet the demands of local and foreign markets.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

The Cotacachi high zone was identified as a micro-center of biodiversity through studies on genetic variability and morphological characterizations. Six farms representing settlers and indigenous people in three sectors of the Andean Region (north, center and south) have been selected to study production systems and seed systems models. At community level an inventory of most representative crops was completed in order to know the genetic richness and define a micro-center of diversity.

Conservación y manejo de la agrobiodiversidad en la cordillera de El Cóndor – "Apoyo al manejo sustentable de los recursos naturales en la zona de amortiguamiento de la cordillera de El Condor, mediante el mejoramiento de los sistemas de produccion en comunidades indigenas y de colonos"

Country: Ecuador
Organization: INIAP, SDC
Budget: N/A

DESCRIPTION OF THE INTERVENTION

This INIAP project is part of the programme for the conservation of the Condillera El Condor funded by the SDC. INIAP work targeted conservation and sustainable use of plant genetic resources of the Shuaras indigenous people in Gualaquiza to contribute to food security, maintain ethnobotanical knowledge and preserve agricultural biodiversity in the mountains of El Condor (INIAP, 2005). The role of SDC in the project was to expand the coverage of existing services to support agricultural and forestry production, contributing to the conservation and sustainable use of biodiversity, increasing the participation of local governments in the sustainable development of the area, and create and implement an agile, flexible and participatory funding mechanism for ongoing initiatives.

Activities:

1. Identification of micro-center of agrobiodiversity: the project has provided technical assistance for the realization, organization and execution of the first two "Fruits, Medicinal Plants and Tropical Amazonian Roots Conservation Fairs" in 2004 and 2005, where the germ-plasm exchange was found to be very active. According to the material collected in Gualaquiza (fruits, medicinal plants and Amazonian tropical roots) the area has a rich in agrobiodiversity.
2. Study of the use of agro-biodiversity on farm and development of a conceptual model: socio-economic and agronomic studies of 50 representative farms were carried out in order understand the components and interactions to generate a farm system model for each of the ecosystems identified and recommen appropriate changes in on farm management in the area.

3. A communal gene-bank has been installed in Gualaquiza, to facilitate the delivery of products such as: production of neglected and underutilized species and medicinal plants in danger of extinction; investigation on regeneration cycles and production conditions; establishment of community seed banks; training and workshop on management and conservation of agricultural biodiversity and establishment of priority species, documentation and development of a concept of communal management of seeds. A conservation garden with the collections collected has been implemented.

RATIONALE OF THE INTERVENTION

The Cordillera del Condor is in the southeast of Ecuador, between 200 and 2800 m, covering three different types of climate and vegetation and identified as an area of high biodiversity and endemism. The area is inhabited by approximately 44,000 people who live mainly from agriculture. The production system differs according to ethnicity: "mestizos" have a market-oriented production system, contrasting with the subsistence-oriented production system of indigenous people (Shuaras). The high biodiversity in the area is being lost mainly to deforestation and unsustainable agricultural practices.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Diagnostic work showed that the preservation of plant genetic resources used by the Shuar requires complementary conservation methods, which involve a combination of *in situ* and *ex situ* methodologies.

OTHER

Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el Noroccidente de Pichincha

Country: Ecuador
Organization: FURARE (Fundacion Rainforest Rescue), UNDP
Budget: N/A

DESCRIPTION OF THE INTERVENTION

This project aimed to retrieve forest biodiversity through sustainable management of livestock farms in the communities of Nuevo Mundo and Ganaderos Orenses, northern Pichincha, through analog forestry. This is a system which seeks to establish analog ecosystems with architectural structures and ecological functions similar to the original climax or sub climax vegetation. It also seeks to strengthen rural communities, socially and economically, through the use of species that provide commercial products (ITACAB, 2002). Implemented between 1998 and 2000, the project aimed to increase biodiversity and create biological corridors to ensure environmental stability on farm and obtain new products for both household consumption and marketing through farmers' training.

Specific Objective:

1. Recover part of forest biodiversity through sustainable management of livestock farms in the communities of Nuevo Mundo and Ganaderos Orenses.

Activities:

2. Increasing biodiversity: Application of Analog Forestry techniques designed to also increase sources of income for farmers
3. Marketing: creation of a community store to market products produced on farm
4. Research: creation of a Database with information on 50 species with the potential for analog forestry
5. Training: training aimed at strengthening local forest management skills.

The communities involved produce all their products collectively, distributing gains collectively. The project has formed three productive groups: producers of nursery plants and orchis, producers of bamboo and straw handicrafts, producers of dairy products.

RATIONALE OF THE INTERVENTION

In the northwest area of Pichincha, colonization has produced an accelerated process of deforestation because of expanding agricultural frontiers, grassland areas and timber extraction. Agricultural production is very low and mainly used for self consumption.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

N/A

Conservation of Biodiversity in Pastaza

Country: Ecuador
Organization: INSTITUTO QUICHUA DE BIOTECNOLOGÍA SACHA SUPAI, GEF (Global Environment Facility)
Budget: US$ 763.000

DESCRIPTION OF THE INTERVENTION

This project was developed between 2003 and 2005 by the Inter-institutional Network of Specialists in Environmental Management, which incorporates the Quichua Institute of Biotechnology (IQBSS), the Amazon Environmental Institute of Science and Technology ("Amazanga" IACYT-A), the Technological Center of Amazon Resources, and the Omaere Foundation. The network is a combination of local NGOs that work on environmental issues in the province of Pastaza, and technicians from the Quechua communities (GEF, 2006). The area of intervention of the project circumscribed the territories of the Quichua communities of Yana Yacu, Nina Amarun and Lorocachi, located in the border area of the province of Pastaza. The goal of the project was to contribute to global ecological equilibrium and maintenance of biological diversity through the conservation and sustainable use of the resources of the Amazon forest in the province of Pastaza.

Specific objectives:

1. To conserve and attain *in situ* management of the ecosystems and biodiversity of the Amazon forest in the territories of the indigenous communities of Pastaza through the implementation of three components: design and application of Management Plans in three community territories; establishment of a Socio-Environmental Information Center for the Indigenous Territories of Pastaza; design and implementation of a Capacity-Building program on Environmental and Natural Resource Management.

Activities:

1. Communal environmental management plans and pilot projects: biological studies; socio-economic studies; participatory design of management plans; biodiversity sustainable management pilot projects
2. Establishment of a socio-environmental information center for the indigenous territories of Pastaza: construction of basic infrastructure, purchase of hardware and software; design of geographic information system linked to the socio-environmental data base.
3. Design and Implementation of a training program on environmental and natural resources management.

RATIONALE OF THE INTERVENTION

The area of intervention of the project circumscribed the territories of the Quichua communities of Yana Yacu, Nina Amarun and Lorocachi, located in the border area of the province of Pastaza. Consisting of approximately 250,000 hectares of tropical rainforest characteristic of the Amazon region, the global surface area of the three territories is home to a total of 300 indigenous Quichua inhabitants who fundamentally sustain their family economy through low productive agriculture, hunting and subsistence fishing.

These territories are traversed by two important hydrographic basins, the River Curaray to the north and the River Pinduc to the south. Between these two water basins there is a mosaic of terrestrial forest ecosystems and aquatic ecosystems, whose diversity could be considered one of the greatest on the planet, based on the results obtained from the studies conducted.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Plans designed by the communities to manage strategic biological resources in the 250,000 ha. area spanning the community territories of Yana Yacu, Nina Amarun and Lorocach were developed including three principal components: a proposal for community zoning based on ancestral criteria of land use, a proposal of Community Standards for the sustainable management of the principal biological resources of the territory, and a proposal for projects to recuperate the quality of life of the families in the three communities.

Seed systems. The biological foundations of security in the Andes

Country: Ecuador
Organization: World Neighbours, DIPEIB, FUNPRODIB, Wageningen University
Budget: N/A

DESCRIPTION OF THE INTERVENTION

The project was implemented between 2005 and 2009, to empower local communities in Ecuador's central highlands to create and sustain functional seed systems that will help them combat food insecurity; interactively explore and act upon opportunities to strengthen seed systems; and interact locally while directing seed selection, variety development, conservation and exchange through participatory learning.

Specific objectives:

1. To work with marginal communities in order to gain a new understanding of their knowledge gaps and the structural barriers that effect local seed systems. This includes improvement of local species, management of genetic resources and informal seed exchange systems.
2. To improve the ability to access quality seeds from different plant varieties through the design and strategic intervention testing for ecological literature focused on botany, seed multiplication, local plant improvement, communication systems and seed exchange.
3. To document, disseminate and promote applications from the lessons learned among rural development actors (farmers' organizations, development agencies, research institutions and politicians), and to present promising methodologies to facilitate the promotion of interest in food security through better managed informal seed systems.

Activities:

1. Meetings and workshops to update the annual workplan and define participatory rural appraisal methodologies with local organizations; socioeconomic research on informal seed systems and farmers' participative appraisal of informal seed markets;
2. Establishment of Seed Guardian groups by local organizations; capacity building for Seed Guardian group members on seed improvement techniques
3. Training in management of seed systems and community improvement also through farmer-led experiments; replication of learning activities discovered at the grassroots.
4. Develop methodological guidelines to improve seed management and production systems for the communities

RATIONALE OF THE INTERVENTION

Vibrant seed systems play a critical role in alleviating poverty and food insecurity in rural communities by improving the productivity and bio-diversity of small-scale farming. Local seed sources are particularly important in areas of extreme poverty in the Andes where farmers live far from commercial markets, research and support services. For communities in isolated areas, the loss of seed can mean food scarcity and periods of starvation. In the central highlands of Ecuador, local seed systems have become dysfunctional and the vast majority of farmers lack access to the crop varieties they need to ensure their families' food security.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

Diagnostic work has been carried out through participative rural analysis of knowledge, attitudes and practices related to existing and potential seed systems, and socioeconomic studies on seed systems and informal seed markets.

Removing Obstacles to Direct Private-Sector Participation in In-situ Biodiversity Conservation

Country: Bolivia
Organization: PROMETA, Global Environment Facility (GEF)
Budget: US$ 1,132,800

DESCRIPTION OF THE INTERVENTION

The objective of this GEF funded project, implemented by PROMETA between 2002 and 2005, is to facilitate the development of private conservation initiatives that will contribute to globally significant biodiversity conservation in high-priority eco-regions (GEF – PROMETA, 2002). This is done through strengthening the regulatory and incentives framework, testing innovative conservation initiatives on four pilot sites, strengthening the technical capacity of private landowners, and disseminating the lessons learned throughout Bolivia and Latin America.

Specific objectives:

1. Regulatory and Incentive Framework: The objective of this component is to strengthen the regulatory and incentive frameworks for private conservation.
2. Pilot Areas Creation and Management: The objective of this component is to demonstrate the benefits of private conservation instruments and incentives through pilot area experiences.
3. Capacity Building for New Initiatives: The objective of this component is to encourage and enable landowners outside of pilot sites to participate in private conservation.
4. Dissemination: Project results will be documented and disseminated over the Internet and by mail to project stakeholders, national and international NGOs, national and local authorities, academic institutions. Project results will also form part of a broader dissemination campaign in Bolivia targeting the public in general, and communities in and around key protected areas

Activities of the project therefore include:

1. Regulatory and Incentive Framework: incentive proposals developed and discussed; practical "how to" guide distributed to pilot area landowners, government agencies;
2. Pilot Areas Creation and Management: creation of four pilot areas;
3. Capacity Building for New Initiatives: 100 landowners participating in Private Conservation Group meetings and events, capacity building activities;
4. Dissemination: Best practices identified and documented; information and project results disseminated to national, international stakeholder groups and target public audiences in Bolivia

RATIONALE OF THE INTERVENTION

Bolivia's biodiversity is threatened by the accelerated destruction of habitats caused primarily by deforestation due to the conversion of land to agriculture and cattle ranching, commercial logging, fires and human settlement in rural areas. Existing regulations, incentives and capacities for *in situ* biodiversity conservation in Bolivia are limited in such a way that there is little direct participation in biodiversity conservation by important sectors such as private landowners and NGOs. As a consequence, the Bolivian government is left as the principal and virtually sole protagonist, with the limitations that this situation entails for maximizing the overall impact and sustainability of national biodiversity conservation efforts. By introducing innovative instruments for private conservation, important lands could be protected where the application of conventional instruments is socially and/or financially unfeasible.

DIAGNOSTIC WORK LEADING TO THE INTERVENTION

While a number of instruments for *in situ* biodiversity conservation, both public and private, exist in Bolivian legislation, an analysis of these instruments as they have been applied in practice revealed that most have failed to significantly contribute to biodiversity conservation.

INDICATORS

The objective of this literature review is to analyze the indicators used in projects aimed at *in situ* conservation and understand the links between objectives, activities implemented to achieve them, and diversity and livelihood outcomes, in order to trace a preliminary best practices pathway. To achieve this result we have studied in detail the reports from the 26 *in situ* conservation projects. The information we rely on to understand the links between activities, outputs and outcomes is based on the indicators used in the projects to assess their results. In specie, we have focused our attention on indicators of change in diversity and livelihoods. In order to retrieve this information we have analyzed in-depth the projects' reports. Before proceeding to the analysis we introduce the Sustainable Livelihoods Approach, which is used in the choice of relevant indicators.

MEASURING CHANGES

The **Sustainable Livelihoods Approach (SLA)** is a widespread framework used to evaluate the magnitude and mechanisms through which agricultural research can help improve the livelihoods of poor people (Adato and Meinzen Dick, 2002). The building blocks of livelihoods are called assets and they can be categorized in five classes:

1. **Natural Assets** (e.g. land, water)
2. **Social Assets** (e.g. formal and informal networks)
3. **Human Assets** (e.g. education, knowledge, health)
4. **Physical Assets** (e.g. equipment, transport)
5. **Financial Assets** (e.g. access to credit)

These assets are combined in the pursuit of different livelihood strategies: intensify productivity, diversify income, etc. (CGIAR, 2008).

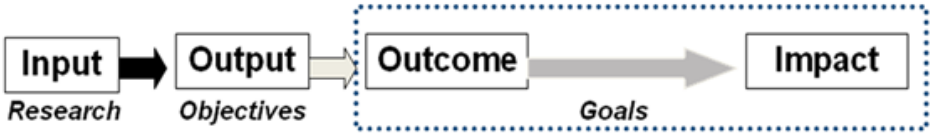
These assets are combined in the pursuit of different livelihood strategies: intensify productivity, diversify income, etc (CGIAR, 2008). In order to assess the impact of agricultural research on livelihoods many impacts must be considered which can be:

- **Direct/ Indirect:** direct quantitative impacts include higher productivity, improved yields and higher income, while qualitative impacts can be in terms of reduced vulnerability, improved knowledge and agricultural practices.
- **Quantitative/ Qualitative:** quantitative impacts include lower food prices and changes in off-farm work opportunities, while qualitative impacts include positive externalities on the community due to the diffusion of knowledge on improved natural varieties
- **Other**: tangible (income change because of higher yield); intangible (changes in empowerment); positive (effects on participants' income and knowledge); negative (less access to natural resources, reduced soil fertility); intended (more yield); unintended (fewer rural jobs); temporary (yield increase in a year); permanent (yield stabilization); short-term (increased resources); long-term (better farming knowledge).

THE IMPACT PATHWAY

The impact pathway is a conceptualization of a project, program or organization's envisioned pathway towards achieving impact (La Rovere and Dixon, 2007). It includes inputs, outputs, direct and intermediate outcomes and impact (e.g. on livelihoods, diversity). Thus impact evaluation must be done through the analysis of program objectives, activities developed to achieve them, immediate outputs, intermediate and final outcomes (also called impacts). This represents the logical framework of an intervention or the management tool used to improve the design of interventions, most often at the project level (OECD, DAC Glossary). It involves identifying strategic elements (inputs, outputs, outcomes, impact) and their causal relationships, indicators, and the assumptions or risks that may influence success and failure. It thus facilitates planning, execution and evaluation of a development intervention (OECD - DAC Glossary). Figure 6 shows the chain of events and outcomes that links outputs to goals and represents the impact pathway.

Figure 6: Impact pathway



CGIAR (2009)

To better understand the concepts of outputs, outcomes and impact we have reviewed their definition according to different international agencies and institutions (Annex … :). We find useful clarifying the definition of these concepts considering that they are seldom explicitly developed in the projects' reports we have analyzed, which seems to indicate an overall confusion (or lack of uniform, agreed upon definition) over indicators of outputs, outcomes and impacts. This is true despite leading international institutions have developed a more or less similar definition of these concepts, which is summarized below (for the sake of completeness we also provide the definition of inputs).

Inputs

Inputs are the financial, human, material, technological and information resources used for the development intervention.

Outputs

Outputs are the products, capital goods and services that represent the tangible, measurable, and immediate results of the intervention. Outputs may also include changes resulting from interventions, which are relevant to achieving outcomes. Bottom-line, outputs are products of interventions and result in changes that achieve outcomes.

Outcomes

Outcomes are the likely or achieved short-term and medium-term effects or changes brought about by an intervention's outputs. They represent changes in development conditions which occur between the completion of outputs and the achievement of impact.

Impacts

Impacts are the positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended. They represent the changes in the lives of people, as perceived by them and their partners at the time of evaluation, plus sustainability-enhancing change in their environment to which the project has contributed.

SELECTING INDICATORS

Having set the definition of outputs, outcomes and impacts, it is important to understand how they can be measured, which is generally done through the use of indicators. International institutions fundamentally agree on the definition of indicators and the criteria for selecting them (see Annex for detailed definition by different institutions).

Indicators are defined as quantitative or qualitative factors or variables that provide simple and reliable means to measure achievement, reflect changes connected to an intervention, or help assess the performance of a development actor. Therefore, indicators are increasingly important in summarizing the progress and direction taken by development-related activities (CGIAR, 2008).

Indicators can measure inputs, outputs, outcomes, and impacts:

- **Input indicators** measure the various financial and physical resources dedicated to a goal.
- **Output indicators** measure and verify the production of outputs, meaning the goods and services that are produced by the inputs. They have quantity, quality, and time attributes.
- **Outcome indicators** relate to the results expected or achieved at the end of the intervention. They help verify that the intended positive change in the development situation has actually taken place. Key elements which contribute towards well-being (e.g. use and satisfaction with public services)
- **Impact indicators** provide a broad picture of whether the developmental changes that matter to the involved organization are actually occurring. They measure the achievement of the ultimate goals of public policies and programs. Measures key dimensions of well-being (freedom from hunger, literacy, good health, empowerment, and security).

For instance, the output “local technicians trained” can be measured by the output indicator “50 technicians trained by the end of Year 1”. Likewise, for the outcome “establishment of a local system for the provision of technical assistance to increase the quality and yield of native crops” an outcome indicator could be “the community leaders have established a local system for the provision of culturally accepted technical assistance for a better production of native crops”. Finally, for the impact “to contribute to the increase of food security levels in poor rural populations through the improvement of the production and commercialization of various native varieties” an impact indicator could measure “increased quality of and access to resources, adoption of behaviors that promote food security, and increased institutional capacities”.

Livelihood impact indicators are designed to measure changes in households’ access to assets, institutional structures and livelihood strategies (CGIAR, 2008) and should be:

- Outcome focused: both quantitative and qualitative data are useful to assess the final outcomes, and help understand hidden or unintended impacts.
- Process based: the quality of the process that leads to those outcomes is important.
- Negotiable and open-ended: indicators must be contextualized and assess both positive and negative trends.

Following the World Bank (2004), good indicators must entail certain characteristics:

- Be direct, unambiguous measure of progress: an increase or decrease of the indicator is invariably better. For instance, immunization coverage expenditure can be positive if it reflects an increase in household resources for health, negative if it reflects a disease incidence increase.
- Vary across group, areas, and over time: child malnutrition is more likely to vary quickly over time than life expectancy.
- Have a direct link with interventions: for instance, it is not appropriate to make vehicle-operating costs an indicator to assess the condition of roads, because indirect intervening factors, such as oil prices, can produce a bias.
- Be relevant for policy making: indicators must be coherent with the level of disaggregation relevant for decision-making (e.g. national, regional).
- Be consistent with the decision-making cycle: use indicators that are timely and appropriate.

The SLA ultimately puts strong relevance on the observable outcome indicator of the project that is most relevant to the intervention logic.

The Sustainable Livelihoods Approach measures changes in factors that affect livelihoods, such as capital assets, institutional structures or processes, the resilience or vulnerability of households, and livelihood strategies. SLA also provides a checklist to design indicators and understand the links between them.
When selecting performance indicators six elements should be kept in mind:

1. **Validity** - Does it measure the result?
2. **Reliability** - Is it a consistent measure over time?
3. **Sensitivity** - When the result changes will it be sensitive to those changes?
4. **Simplicity** - Will it be easy to collect and analyze the information?
5. **Utility** - Will the information be useful for decision-making and learning?
6. **Affordability** -Can the program/project afford to collect the information?

Indicators need to be chosen to be specific and **relevant** to the issue in hand (Bollom, 1998). Quests for universal sets of indicators can be constraining because the choice of indicator depends on the objectives of the policy, program or project being assessed and the conditions under which the indicators are used.

A criterion for selecting indicators is the **SMART** criterion or that indicators must be **S**pecific, **M**easurable, **A**ttainable, **R**elevant, **T**imebound. The main considerations are the feasibility of collecting data which can be quickly and easily used at specific points in the project management cycle. Due to the increasing emphasis on participatory assessment and context diversity, the **SPICED** criterion was developed. SPICED indicators are: **S**ubjective, **P**articipatory, **I**nterpreted, **C**ross-checked, **E**mpowering, and **D**iverse. This criterion focuses more on relevance of indicators to different stakeholders and their accurate representation of complex realities.

Table 2: SMART and SPICED indicators (Adapted from Bond Guidance Notes Series (2005) and UNDP Signposts of Development)

SMART		**SPICED**	
Properties	Definition	Properties	Definition
Specific	Reflect what the project intends to change: is it clear what is being measured? Does it capture differences across areas and categories of people	**Subjective**	Contributors have a special position or experience that gives them unique insights which may yield a high return on the evaluators' time. What may be seen by others as 'anecdotal' becomes critical data because of the source's value.
Measurable	Must be precisely defined. Measurement and interpretation unambiguous and objectively verifiable and reliable. Comparable across projects allowing changes to be compared.	**Participatory**	Indicators should be developed together with those best placed to assess them. This means involving a project's ultimate beneficiaries, but it can also mean involving local staff and other stakeholders.
Attainable	Achievable by the project and sensitive to change. Are the results realistic?	**Interpretable**	Locally defined indicators may be meaningless to other stakeholders, so they often need to be explained.
Relevant	Feasible time and money to collect data using chosen indicators. Is it relevant to the intended outputs and outcome?	**Cross-checked**	The validity of assessment needs to be cross-checked, by comparing different indicators and progress, and by using different informants, methods, and researchers.

Timebound	Describes when a certain change is expected.	**Empowering**	The process of setting and assessing indicators should be empowering in itself and allow groups and individuals to reflect critically on their changing situation.
		Disaggregated	There should be a deliberate effort to seek out different indicators from a range of groups, especially men and women. This information needs to be recorded in such a way that these differences can be assessed over time.

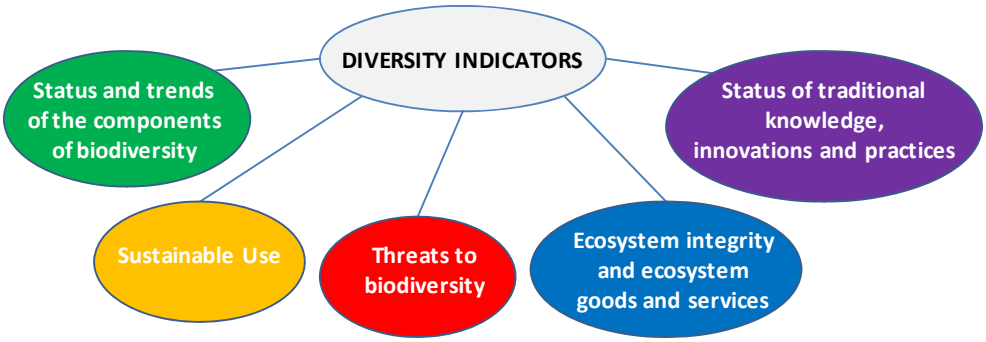
Summarizing the process of evaluation poses a number of challenges, bounding the evaluator to follow certain criteria which are seldom verified by available indicators. In the next section, we will review the impact pathway developed by the projects studied and the indicators used to measure output, outcome and impact achievements.

DIVERSITY INDICATORS

According to the Convention on Biological Diversity "biodiversity indicators are information tools, summarizing data on complex environmental issues to indicate the overall status and trends of biodiversity. They can be used to assess national performance and to signal key issues to be addressed through policy interventions and other actions. The development of indicators is important for monitoring the status and trends of biological diversity and acquiring information on ways to continually improve the effectiveness of biodiversity management programs.

Through the analysis of *in situ* conservation projects carried out in the Andean region, we have been able to trace some common indicators used to assess the results and achievements of interventions. Moreover, we have synthesized and grouped biodiversity indicators into common thematic areas, following the Biodiversity Indicator Partnership (Secretariat of the Convention on Biological Diversity, 2006), as shown in figure 7 (next page).

Figure 7: Selected diversity indicators



We would like to point out that the labeling of indicators is a useful exercise for systematization, but as it will arise from the following sections, indicators are variously interlinked. While this may give the impression of redundancy, the repetition of some concepts under different titles follows from the strong relations between the indicators, and we have tried to emphasize it.

Table 3 (next page) provides a schematic description of the diversity indicators we have selected as useful in the context we are studying, and the expected outputs they measure. After the table, a short comment on each indicator and related outputs, with references to the projects which developed more activities in each focal area.

Table 3: Selected diversity output indicators

Domain	Focal Area	Expected Output	Indicator
DIVERSITY	**Status and trends of the components of biodiversity**	- Improved status and trend in abundance and distribution of selected species - Improved availability of genetic diversity - Protection and conservation of life support systems and ecosystem services	- Lists/ maps of geographical areas where important biodiversity is found - Area covered by selected varieties, cultivars, breeds of cultivated plants and/or domesticated animals and their wild relatives - Repatriation and multiplication of native varieties - Availability, distribution and exchange of good quality seeds - *Ex situ* crop collection - Number of threatened or declining ecosystems, species and varieties restored or rehabilitated
	Sustainable use	- Sustainable management and use of biological diversity - Sustainable human exploitation of ecosystems or land-use type - Proportion of products derived from sustainable sources	- Number of areas under sustainable management - Number of species under sustainable use - Practices that use living materials such that yield or harvest can be maintained over time - Increase in the sustainable production and trade of species and related products
	Threats to biodiversity	- Reduction in overexploitation - Reduction in nitrogen deposition and the use of chemicals causing the loss of biodiversity	- Practices reducing overexploitation of natural resources - Use of organic and other practices reducing the use of synthetic fertilizers
	Ecosystem goods and services	- Improvement in health and well being of communities - Improvement of biodiversity use for foods and medicine	- Assessment of nutritional status of biodiversity - Actions to improve health and well being of communities - Actions to improve the use of biodiversity for food and medicine
	Status of traditional knowledge, innovations and practices	- Resource base of selected species maintained through *in situ* and *ex situ* methods - Knowledge on high quality traits in target species and selection of best varieties - Improved planting material available	- Number of *ex situ* accessions - Extent of on farm maintenance - Seed and planting material quality, quantity and availability - Agronomic practices improved and applied - Number of yield and quality

Domain	Focal Area	Expected Output	Indicator
			improvement practices and facilities - Traditional knowledge collection and maintenance systems

1. STATUS AND TRENDS OF THE COMPONENTS OF BIODIVERSITY

The indicators found in the projects within this focal area measure the richness of diversity through assessment and mapping of abundance and distribution of selected species, change in status of threatened species, inventories and trends of genetic diversity of domesticated animals and cultivated plants of major socio-economic importance, and the identification of microcenters of diversity. Most of the projects we have analyzed in the Andean region assess the trends of the components of biodiversity by observing seed and conservation fairs and the seed flow throughout the region. These are indicators of genetic variability in a specific geographic area as they help identify the species and varieties grown by farmers and facilitate the exchange of germplasm between them, thereby fostering genetic diversity. Fairs also foster the exchange of knowledge and information between farmers and help strengthen cultural and indigenous identity through the promotion of traditional uses, recipes, and customs. Finally, seed exchange helps practitioners characterize and learn more about agro-biodiversity that farmers have on their farms, while favoring the increase, strengthening and replication of varieties. As seed exchange is mainly a local process between families within neighboring communities via barter and sale and at risk of transferring pests and diseases, many projects also focused on monitoring the seed flow after returning cleaned varieties to farmers or training them in seed cleansing and disease prevention. The repatriation of varieties results in increased volumes of high quality seeds available to peasant families and in the return of native seed to local markets. Some of the projects also had a genetic improvement component in order to obtain material with outstanding agronomic characteristics and provide varieties of better quality and resilience to the Andean climate, subject to unexpected periods of frost, hail and drought. The breeding work is generally focused on minimizing the effect of the main limiting factors of production such as drought, frost, pests and diseases.
Some projects were also active in the collection and widening of accessions in national or communal germplasm banks such as the National Germplasm Bank of Andean Roots or the National Germplasm Bank of High Andean Grains, complementing on farm conservation with *ex situ* activities.

Most active projects in this focal area are: Proyecto Integral Las Huaconas; Proyecto Integral Candelaria; Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha; Biodiversity of Andean tubers; Conservación complementaria *ex situ - in situ* de especies silvestres de quinua y cañahua en Bolivia; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Sustainable production of quinoa; Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA

2. SUSTAINABLE USE

Among the most important actions to ensure that ecosystem goods and services are still available for future generations is to manage and use sustainably the components of biodiversity. This is fundamental for safeguarding livelihoods and preserving and improving human development options in the future. Assessing whether a resource is being used sustainably or unsustainably requires consideration of a number of factors, an analysis not available in the information we have gathered on the projects, and is beyond the scope of our study at this stage which is to review the interventions of on farm conservation in the Andean region and not

to assess their impact. However, we have checked which projects had a component directly aimed at improving the sustainable use of genetic resources, ecosystems and a sustainable management of farms.
Indicators in this focal are thus measure land use change and land tenure, types of protection measures in place, conservation, soil formation and sedimentation processes, and nutrient cycling amongst others. Also indicators available in some projects include methodologies for the sustainable use of land-use types, reduction in chemicals and synthetic fertilizers also through organic and alternative cultivation methods, reduction of deforestation through the valorization of forest products, and establishment of sustainable local systems of seed supply and technical support that can increase the quality and yield of cultivars.

The projects which had a specific focus on sustainable practices are: Lupin/ Quinoa; Native Potato; Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi; Green manure and legumes; In-Situ Conservation of Native Cultivars and Their Wild Relatives – Peru; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Cover agriculture; Sustainable production of quinoa; Sustainable production of quinoa; Desarrollo Sostenible de Quinua Orgánica en el Perú

3. THREATS TO BIODIVERSITY

The food and agriculture sector can contribute to the loss of biodiversity components through land-use change, loss of nutrients, and overexploitation of natural resources. The projects we have studied were focused on fighting the determinants of biodiversity loss on farm, which are linked to bad cultivation and processing practices affecting the quality, nutrient content and productivity of soils, but also the resilience of native varieties to pests, diseases and adverse weather conditions. A special attention in the projects analyzed was given to improving agricultural efficiency through better planting, harvesting and storage practices but also to addressing specific pests and diseases, such as weevils and moths. The awareness and extent in use of methods of integrated pests management and practices that reduce soil exploitation or improve soil quality are the main measures of projects outputs within this focal area.

Projects that had a special focus on the incidence of on farm biodiversity threats are: Lupin/ Quinoa; Programa de apoyo a la quinoa altiplano sur; Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Potato moth; Biodiversity of Andean tubers; Sustainable production of quinoa; Green manure and legumes; Desarrollo Sostenible de Quinua Orgánica en el Perú

4. ECOSYSTEM GOODS AND SERVICES

Goods and services from biodiversity to support human well-being, including medicine and food, represent outputs that are strongly linked with livelihoods outputs and outcomes. These goods and services help achieve sustainable livelihoods, local food security and health care, especially for poor and marginal people who are directly or indirectly dependant on local biodiversity for their survival. Outputs in this focal area are therefore measured through the actions taken to assess the nutritional status of targeted species or to improve the hygienic and consumption habits of different community members, and a better use of local biodiversity for food preparation and medicinal purposes. Considering the strong interlinks with livelihood benefits, these indicators are similar and connected to livelihood indicators in terms of enhanced capacities and knowledge of different stakeholders and nutritional awareness.

Projects which had specific activities in this focal area are: Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Conservation of Biodiversity in Pastaza; Conservación y manejo de la agrobiodiversidad en la cordillera de El Cóndor; Proyecto Integral Las Huaconas; Proyecto Integral Candelaria; Proyecto Integral Altiplano; Lupin/ Quinoa; Green manure and legumes; In-Situ

Conservation of Native Cultivars and Their Wild Relatives – Peru; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Desarrollo Sostenible de Quinua Orgánica en el Perú

5. STATUS OF TRADITIONAL KNOWLEDGE, INNOVATIONS AND PRACTICES

Indigenous and local communities play a fundamental role in the conservation of biodiversity through their traditional and close dependence on biological resources. The preservation of ancient practices and values linked to local diversity and handed down knowledge and traditions can help achieve conservation objectives and sustainable use of natural resources, respectful of the relationship that indigenous communities developed with nature through centuries. However, innovation is also necessary in order to improve practices that are sometimes harmful to soil conservation and targeted species, and many projects have focused on improving traditional practices. Outputs in this area are thus measured by the creation of systems to document and maintain traditional knowledge, by innovations that increase the availability of good quality seeds and the improvement of storage and processing facilities, and by the extent of conservation both *ex situ*, through germplasm collections and banks, and on farm, in the number of areas applying conservation principles. Seasonality affects crop prices, which fall during abundance periods, dramatically impacting peasant producers, and unexpected bad weather often destroys harvests. Some projects analyzed the effects of storage system on the nutritional quality of seeds as storage also concerns the conservation of seeds under viable conditions and with their original genetic characteristics, and.

Basically all the projects studied had a component focused on improving traditional practices or complementing them with modern innovations, therefore we are listing those that developed this component incisively: Proyecto Integral Candelaria; Biodiversity of Andean tubers; Lupin/ Quinoa; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA; Desarrollo Sostenible de Quinua Orgánica en el Perú

LIVELIHOOD INDICATORS

Livelihood indicators are not easy to categorize as the different spheres to which they belong often fit into different classes. However, through the analysis of projects reports we have chosen to group them in five areas as shown in figure 8 (next page). Table 4 (next page) schematizes the livelihood indicators we have found in the projects and the expected output they measure.

Figure 8: Selected livelihood indicators

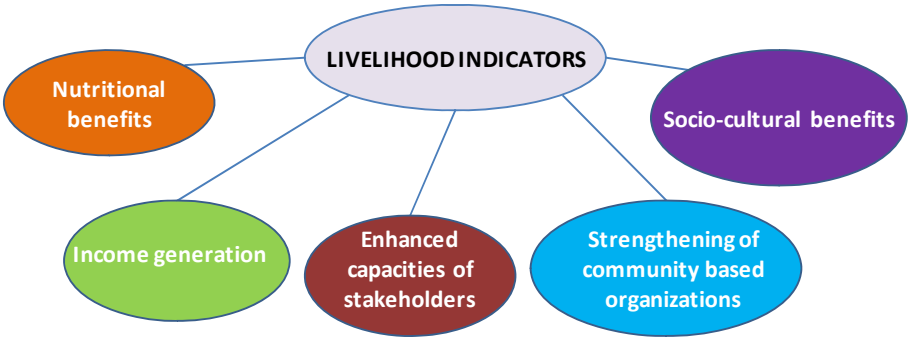


Table 4: Selected livelihoods output indicators

Domain	Sub-group	Expected Output	Indicator
LIVELIHOODS	**Nutritional benefits**	- Nutritional value of target species assessed - Current and potential impact of target species evaluated across social groups and priority areas - Improved nutrition through dissemination of diet diversification strategies	- Availability and use of nutritional information - Documented strategies for nutritional security across differentiated groups - Strategies applied for the improvement of household nutrition, especially through women training
	Income generation	- The supply chain of targeted species and impact across their actors is assessed - Data on economics and cost benefits of the commercialization of targeted species gathered - Value adding strategies developed	- Information on supply chains is available do different stakeholders - Documents analyzing cost benefit and commercialization opportunities - Documented strategies for added value products - Changes in crop choices by growers
	Enhanced capacities of stakeholders and sharing of knowledge related to biodiversity	- Better knowledge and technology transfer - Enhanced capacities of community members involved in biodiversity conservation - Community-based add-value units established - Courses and curricula on targeted species established	- Knowledge and technologies improved, shared, transferred and applied - Availability and use of improved cultivation practices, production and marketing - Number of farmers, technicians and scientists trained - Information and methods documented/ published - Curricula on target species developed
	Strengthening of community based organizations	- CIALs, ECAs and other associations established and/or legally recognized - Pre-existing local organizations strengthened - Increased participation of community members to local organizations - Empowerment of women	- Number of organizations established/ legally recognized - Strategies to strengthen organizations - Number of community members that participate - Assessment of potential for women empowerment through cultivation and use of targeted crops - Women organizations established/ strengthened - Courses/ events targeted at women

Domain	Sub-group	Expected Output	Indicator
	Socio-cultural benefits	- Traditional, indigenous and spiritual knowledge and practices linked to local biodiversity preserved - Self-esteem of producers, farmer leaders and biodiversity promoters raised - Better legal and policy frameworks for access and benefit sharing related to biodiversity - Public awareness raised on the role of biodiversity in livelihoods	- Traditional and spiritual practices preserved and passed on - Number of key actors whose role is recognized in the communities - Actions, strategies and policies to improve access to and / or rights over biological resources - Public awareness and promotion materials produced and spread to different stakeholders

1. NUTRITIONAL BENEFITS

The knowledge of food preparation and purchase, patterns of consumption and sharing, beliefs and rites associated with certain foods, and how this knowledge itself is transferred from one generation to the next are important components of the food system in the Andes. Some of the projects analyzed have carried out studies on ancestral consumption habits, the nutritional values of Andean crops, and their culinary uses and properties in order to improve the nutritional intake of families and communities. Outputs in this focal area are measured through the documentation of ancestral forms of consumption, the preparation of new recipes, teh improvement of dishes preparation in order to maintain higher nutritional values. Awareness campaigns and workshops for healthy eating practices were also used to improve nutritional knowledge. These activities are generally carried out through the involvement of women trained to support the preparation and promotion of foods derived from local biodiversity, and sometimes in monitoring the frequency of their consumption and the nutritional state of children and pregnant women. Family, school and communal orchards were often created to promote the diversification of food consumption. Seemingly, projects that have addressed this cultural connection have reached the best outcomes in terms of acceptability, adoption, diversification and nutritional improvements. Such activities also help strengthening and maintaining community's interest in target crops and prepare trained people communicate their benefits to others.

Projects which developed a specific component in this focal area are: Proyecto Integral Las Huaconas; Proyecto Integral Altiplano; Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Sustainable quinoa; Lupin/ Quinoa; Conservación complementaria *ex situ - in situ* de especies silvestres de quinua y cañahua en Bolivia; Green manure and legumes; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador

2. INCOME

Although the income potential of local Andean crops is difficult to assess and demand and cultural limitations (such as the distance of farmers from markets, the demand of imported crops, and the view of some native species as 'the poor man's crop') constrain their commercialization, some projects had specific components addressing marketing and income-generation. Quantitative changes in income are related to yield improvement, cost-benefit efficiency, marketing of higher quality products, improvement of profit margins and larger quantities of products to sell. This livelihood indicator is straightforwardly measured in family income gains. Increased income options also mean that the families can diversify their portfolio of productive and remunerative activities thanks to native cultivars production, alternative productive activities such as ecotourism or artisanal production, and transfer of improved technologies and knowledge to other cultivars. The creation of added value products and marketing opportunities also fall under this focal area. Finally, the successful promotion and commercialization of products can also impact, although indirectly, the income of farmers because of larger volumes sold.

Most of the projects developed a promotion component, but only some were focused on income-generating activities or the analysis of income potential and increase through the cultivation of selected crops: Proyecto Integral Candelaria; Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha; Biodiversity of Andean tubers; Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el Noroccidente de Pichincha; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA; Desarrollo Sostenible de Quinua Orgánica en el Perú

3. ENHANCED CAPACITIES OF STAKEHOLDERS AND SHARING OF KNOWLEDGE RELATED TO BIODIVERSITY

Basically all the projects analyzed had a technology transfer and capacity building component. These activities aim to address the negative impacts of inadequate agricultural practices, introducing modern techniques, and to support the sustainable use of natural resources. Moreover, they focus on participatory approaches that help strengthen interactions through different actors in the communities and foster information and knowledge sharing. Training of different stakeholders along the production and supply chains also improves local networks and opportunities for collaborations with different institutions. Training enables farmers to be direct actors in local development, raising self-esteem, enhancing their management skills, increasing their autonomy and strengthening their productive capacity. These activities are generally focused on helping farmers own the practices for improving the production and health of crops and soil in their own plots and therefore accept and adopt them. Without the acceptation of improved technologies by farmers, the outcome of the projects would be in fact limited. Mainly, technology transfer activities concentrate on integrated crop and soil management, recording and evaluation of crops, seed cleaning, breeding, sawing, harvest and post harvest technologies, storage, processing, and soil health protection. Improved agricultural practices are adapted to traditional methods through studies and participatory approaches that identify knowledge gaps and rural knowledge networks. Also organized field days, visits to successful trials, and observation tours have the objective of help farmers and technicians learn about innovative practices, identifying efficient organizations and participatory processes, and understand the benefits of biodiversity conservation. Field days to demonstrative and trial plots, communal short courses and educational tours are used show the superiority of introduced varieties and technologies with the objective of inducing farmers to apply them themselves. Also fairs are a means for local organizations to present the activities undertaken in recovery, valuation and conservation of diversity in the communities they are working with. Finally, age-differentiated courses and workshops are also implemented by several projects in order to amplify the dissemination of activities. Children, for instance, can be educated in appropriate seed cleaning and weevil management and effectively reproduce acquired knowledge with their parents.
Collaborations between projects and universities also led to the implementation of seminars, master, graduate and specialization courses in sustainable management of natural resources and *in situ* conservation. Output indicators in this focal measure for instance the number of farmers that have acquired/adopted new or better agronomic and production technologies, the number of guides, workshops, courses, experimental trials, the rate of participation to activities, but also the informal transfer of knowledge through meetings, exchange of experiences between individuals or organizations and through the cultivation of interpersonal relations, and curricula in education institutions.

Although basically all the projects studied had a component related to technology transfer or capacity building, some of them were more developed under this area: Proyecto Integral Las Huaconas; Proyecto Integral Candelaria; Biodiversity of Andean tubers; Native potato; Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands; Potato moth; Lupin/ Quinoa; Conservation of Biodiversity in Pastaza; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Manejo, Conservación y Uso Sostenible de los Recursos

Genéticos de Granos Altoandinos, en el marco del SINARGEAA; Desarrollo Sostenible de Quinua Orgánica en el Perú

4. STRENGTHENING OR CREATION OF LOCAL ORGANIZATIONS

Many projects were focused on enhancing participatory processes through the creation or strengthening of local associations, particularly under the form of Farmer Field Schools (Escuelas de Campo de Agricultores) and Local Agricultural Research Committees (Comités de Investigación Agrícola Local). The Farmer Field School is a participatory training methodology based on the concept of learning by discovery and focuses on ecological principles. Farmers and facilitators exchange knowledge based on experience and experimentation, while the crop is used as a tool for teaching and learning. Participants learn, adopt, validate and adapt new or better technologies after learning by doing process that enables them to become promoters of conservation in the communities. Farmer Field Schools foster technology adoption and empowerment at the community and personal level. These activities can have a self esteem component when improving the role of people in the community. The Committees on the other side are addressed to professionals of national and international organizations, and to farmers carrying out research. The main objectives of the Committees are to strengthen the capacity of rural communities as decision-makers and agricultural innovators, and increase their power to put a demand on the formal system of research and development. They also provide mechanisms for access to new skills, information and research products that may be useful locally, promoting the generation, adaptation, validation and transfer of technologies. Committees are based on interaction and feedback with the farmers, and take into account their criteria for the selection of new technologies. They thus improve organizational processes, identify priority problems in relation to the projects, and disseminate them to the community and practitioners. Some projects fostered the creation of organizations and associations targeted at different stakeholders such as farmers, producers, and women, in order to increase their bargaining power and recognition in the community.
Projects strengthen local organization's participation and negotiation skills to facilitate coordination, production, marketing and promotion of selected varieties and acquire local incidence. Some projects strengthened local organizations in order to develop agro-industrial solutions such as the construction of community processing plants, conservation silos or micro-enterprises. Moreover, some projects empowered rural networks promoting the exchange of experiences between the organizations through meetings, seminars, workshops, and interpersonal relations.

Projects which strengthened or created Farmer Field Schools were: Native potato; Biodiversity of Andean tubers; Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Potato moth; Lupin/ Quinoa; Cover agriculture; Sustainable production of quinoa; Seed Systems.
Projects focused on Local Agricultural Research Committees are: Proyecto Integral Candelaria, Sustainable production of quinoa, Lupin/ Quinoa, Cover agriculture, Seed systems.
Other organizations and associations, including women organizations, were created in the projects: Proyecto Integral Candelaria, Biodiversity of Andean tubers, Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi; Sustainable production of quinoa; Green manure; Cover agriculture; In-Situ Conservation of Native Cultivars and Their Wild Relatives – Peru; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA

5. SOCIO-CULTURAL BENEFITS

The dissemination of project activities and their results is fundamental for projects to raise awareness on the role of targeted species, the ways to improve their conservation and how they can achieve better nutrition, income and generally livelihood outcomes. For this reason, all the projects examined had a more or less

developed promotion component which can take the form of organized events such as fairs, competitions, seminars, and conferences, but also through tours and exchange visits to share knowledge and techniques with other projects and communities. Through promotion, local, regional or national population recognize and revaluate the benefits of native crops and their services (tourism, food, genetic resources, health), while markets aknowledge their potential. Dissemination is achieved through different media: radio, television, newspapers, fairs, cooking festivals. The radio seems the most effective mean to sensitize the rural and urban population and achieve greater dissemination of knowledge, production and consumption. However, to reach the population best, promotion activities must be well adapted to the local context. School garden installations, workshops and exhibitions also seem efficient means of promotion because they engage the local population. However, their effectiveness depends on the motivation of people to participate. Cooking courses, cookbooks, degustation tests, or seed and recipe contests, are other common activities carried out in the projects. These activities are also linked to actions involving promoters and conservationist leaders or women organizations, through their active participation to household well being and to the community as a whole, which help strengthen their self-esteem and role in the communities.

In some cases, the activities aimed at improving the policy and legal framework connected to the conservation of target species have lead to the incorporation of conservation and sustainable use of agrobiodiversity in the local development agenda, and to the legal recognition of the role of conservationist organizations and communities. By collecting, documenting and disseminating information over the role of traditional and indigenous knowledge and uses of local diversity, projects also contribute to maintaining the cultural background of communities strongly interlinked with local natural resources. Finally, the compilation, organization, systematization and analysis of projects' results in publications aimed at decision makers, institutions, practitioners and technicians, creates growing interest for *in situ* conservation from different stakeholders. Guides for training technicians, agencies, and promoters are the most common type of publication. Academic and research institutions are often involved in the generation of these activities, which strengthens institutional relationships.

As promotion is an activity undertaken by all the projects studied, we list here the ones that specifically focused on improving policy and legal frameworks, on creating conservationist leaders and promoters, and on maintaining traditional knowledge.

Policy and legal framework: In-Situ Conservation of Native Cultivars and Their Wild Relatives; Seed systems; Removing obstacles to direct private-sector participation in in-situ biodiversity conservation; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador.

Leaders and promoters: Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha; Native potato; Conservation of biodiversity in Pastaza; Seed systems; Proyecto Integral Las Huaconas; Proyecto Integral Candelaria; Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Cover agriculture; : In-Situ Conservation of Native Cultivars and Their Wild Relatives; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador.

Traditional knowledge and culture: Proyecto Integral Candelaria; Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha; Andean tubers; Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica; Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador; In-Situ Conservation of Native Cultivars and Their Wild Relatives; Native potato.

DISCUSSION

We will now synthesize the main findings of the literature review by highlighting the common problems emphasized in projects' reports and the activities and approaches that seem more efficient in achieving targeted results.

Common problems stand out from the review

One of the main constraints reported for attracting investment in projects for *in situ* conservation of native cultivars is their **low income potential**. Despite demand needs to be supported through promotion of native cultivars, the main problems are found on the **supply side**: agro-industry is not developed, small, with very limited abilities to develop new products, lack of necessary machines, equipment, capital for purchasing new products, and training in modern practices. Strategies and practices for the management of pests and diseases, cultivation, storage and production must be evaluated and modernized in order to achieve adequate standards of quality, yield, resistance, and conservation. Supply problems also derive from the disorganization of the producers, so that manufacturers are forced to deal with several farmers and producers, thus extending the market chain and increasing the price of the final product. Moreover, most domestic producers don't know the export process, and they do not have the technical and commercial capacity to meet external demand. Training of farmers, technicians and producers in quality management systems is also necessary in order for them to be able to offer competitive products that reach the market with the required quality. The poor state or lack of productive infrastructure such as roads and irrigation, as well as lack of processing equipment, also prevent agricultural products to be competitive in the market. Finally,

In terms of economic impacts most of the projects have encountered many difficulties in generating sustainable economic benefits because the commercialization of native Andean crops is not profitable enough. **Low demand** and low competitiveness are the biggest constraints, connected to the remoteness of conservationist communities from markets. In this respect, fairs and local festivities represent important complementary channels for income generation. The lack of a **market** for Andean products has been addressed by projects through the creation of promotion strategies. However, if **consumption patterns** don't change towards acceptance of these products, their viability will remain a big constraint, reflecting negatively on diversity conservation, nutrition and food security. It is therefore necessary to study the markets of intervention areas and the logic that Andean families apply in the selection and recovery of native seed in order to make it competitive in a market full of imported products.

Technical and economic feasibility studies are also needed to guarantee the viability and sustainability of economic activities proposed by the projects to participants. Some projects stressed the importance of understanding the **socioeconomic segmentation of demand**[2] in designing promotion strategies in order to tackle scarce profitability of the commercialization of Andean crops and related products. Although income is not the only priority of families, the productive affordability of conservation activities must improve in order to achieve better livelihoods and diversity results.

Ex post studies on the effective **recovery** of agrobiodiversity are much needed considering the fact that season after seasons the farmers tend to choose the varieties according to their better adaptation and fewer work required, again threatening diversity. Monitoring is thus a relevant part of impact assessment and is useful to understand which interventions succeed in motivating farmers to maintain diversity.

[2] Quoting the McKnight project 'Strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands': 'in urban marginal neighborhoods of Cusco the most important characteristic of ulluco is its nutritive value and its low price; by contrast, in the richest neighborhoods the most important quality of the ulluco is that is perceived as a healthy product'.

Different types of **Incentives** are important in technology transfer activities and capacity building. Some projects lament that in participatory activities and training sessions people are often more interested in snacks than training. Moreover, local authorities don't have the leadership to motivate the population to pay attention to such events, and people sometimes plan other community activities on the day when trainings are planned. Local institutional and organizational **support** is limited which also constraints the creation of networks and diffusion of project activities. The low interaction and support from the formal and institutional sector to local groups or individual farmers is a great constraint to the sustainability and effectiveness of projects.

One common problem is the late start due to unavailable **funding** and a **bad timing** between organization, planning, availability of funding and implementation of activities, limiting reliable and good results.

Cultural heritage is sometimes a constraint to the application of appropriate practices: for instance, religious practices or myths can limit the adoption of adequate technologies and are difficult to overcome[3]. On the other side, culture is extremely important, for instance rituals are used to propitiate animal's increase and potatoes sowing.

An increase in the quantity of varieties produced is a clear indicator of increased agricultural biodiversity. However, sometimes an increase in the number of varieties produced is not followed by an increase in the volume of varieties sold or used for self consumption, which can lead to the subsequent rejection or abandoning of these varieties by farmers. This indicator must therefore be verified by an analysis of the marketing and self-consumption patterns of the selected varieties. Moreover, farmers' field results are very variable and several seasons are necessary to evaluate effectively productivity improvements.

Finally, the **weather instability** in the Andes limits the outcome of projects: if the rainy or drought season is normal, crop yield good harvest; when it concentrates badly in some periods, crop fails mainly because of diseases. Moreover, climate change is probably accentuating these processes provoking increased difficulties in terms of frost, hail, heavy rains and atypically long drought periods. Although this requires great resources and competencies, adequate climate risk planning and methodologies are necessary in order to avoid efforts being vanished by external factors. This problem is also linked with the fact that most projects studied do not have a big scale and have a limited area of influence, therefore with low capacity of impacting environmental and conservation policies, although some of them were successful in raising policy makers awareness and interest.

Several good practices also emerge from a first analysis of the projects

A common trait of the projects analyzed is the use of **participatory approaches** based on the recognition that to promote rural development through sustainable practices, it is necessary to give participants ownership of the project. In this way, practitioners and farmers' objectives are interlinked and the project is developed addressing specific problems and needs of families and communities. The learning process is therefore based on dialogue, mutual respect and recognition of the fundamental role of **local culture** and **knowledge**. A participatory approach fosters the role of farmers as key players, enhancing their **self esteem** and their recognition in the communities. The best project outcomes are probably achieved bringing farmers and relevant stakeholders inside the process from its design in order to address relevant objectives to its implementation, which helps understanding local response to common problems and adapting solutions in an optimal way.

[3] For instance, the 'Lupin/Quinoa' McKnight project had to face a myth that if potatoes are covered with too much ground they don't thicken although that is not true, and moreover ground keeps moth and maggots away.

Most of the projects used participatory approaches also for the characterization of agro-economics systems. These were carried out to create farm maps (farmers' view and family tasks) and social maps (social environment of farmers), and understand the levels of well being (economic, productive, social aspects). Participatory approaches are successful in identifying knowledge gaps of farmers and technicians and developing learning tools. Participatory research enables investigators to know farmers' selection criteria in terms of plant health, yield, size and color and determine the acceptability of native cultivars.

Overall, projects focused on generating technologies that improve crop management and production systems while being **adapted to the socio-economic conditions** of farmers. One measure of project success is in fact the decision by farmers to apply these practices to other commercial varieties after obtaining good results from targetd crops (economic improvement from the sale of high quality seed is obviously among the main incentives to apply improved practices).

Most of the projects achieved to know and value existing **biodiversity through studies**, inventories and research that also represent an opportunity for communities to know and promote the richness of their areas.

Local Agricultural Research Committees and **Farmer Field Schools** are methodologies often applied for mutual learning-by-doing and are thought to contribute both to conservation and livelihoods, when participants are adequately motivated. Strengthened local organizations and rural networks also acquire better knowledge and management capacity, and their ability to engage the communities is greater.

Institutions such as **schools and universities** seem interested in biodiversity conservation projects and have enhanced and contributed to project activities, creating networks and capacity building.

On the side of training, **demonstration** and **trial plots** emerge as a widely used tool of training and to input strategies before developing them at a broader level. Workshops, field days and visits to other successful experiences complement training activities in a way that engages participants and favors the exchange of experiences, also increasing relations between remote areas. However, the **motivation** of the community to receive training and attending training events and visits is fundamental for success of the project.

It's also important to **measure the level of knowledge** acquired through training. The acquisition of new knowledge, abilities and **skills**, and the environmental awareness raised through information, capacity building and practice, are all intangible outcomes of the projects, but difficult to measure in the short term.

To tackle the limited market for native crops some projects aimed at creating and promoting adjacent **sustainable productive** activities such as **ecotourism** initiatives, use of ornamental and medicinal plants, and artisanal work. However, sustainability and viability plans for these activities are seldom available.

Connected to this, conservation and seed exchange **fairs** seem good in promoting conservation = and consumption of native cultivars while improving the exchange of information between communities and/or gaining income to participating farmers. Local and inter-communal fairs have in fact been identified as important markets to sell and purchase native crops.

Communities seem interested in producing and preparing **alternative recipes** with **nutritious foods**. Culinary contexts, exhibitions and fairs appear to be a good way of engaging local population. Promotion also seems successful especially through the use of radio campaigns.

Practices such as crop association and rotation seem to obtain good results improving other crops' performance, resilience and improving soil health.

Gender and culture are fundamental aspects in the Andean environment. **Women** are often the most prepared on the history of how technologies in the communities were adopted and their development through time, the seed selection and traditional conservation of local varieties, and are aware of the ongoing loss of local biodiversity. However, they have less decision making power than men, who usually focus on cash crops and practices that gain better outcomes in the short term. Notably, the question of **gender issues and women empowerment** in general has not received the due attention. Despite the management of native Andean crops is for a relevant part carried out by women, only 8 out of the 22 projects had a specific component addressed to gender empowerment. Moreover, it would be useful to enquire the result of these activities in terms of the social debate and the response of the community on this theme to understand if a long term impact of gender empowerment has been achieved.

In the case of **indigenous organizations**, where collective action is an ancestral form of organization regulated by right and duties, projects must be particularly careful in adapting to this settled institution. Moreover, **cultural heritage** and indigenous worldview is utterly important in the Andean context, where the concepts of biodiversity or ecosystem cannot be simply internalized by raising awareness, but have to be owned by the farmers themselves in order to be fully accepted and acquired. Another aspect which hasn't been directly tackled in the assessment of projects' results is the impact on traditional inequality relations between classes or ethnicities, which is relevant especially in those projects aimed at the empowerment of indigenous communities through natural resources conservation.

Finally, the projects achieved some impacts at the individual level, in terms of **self esteem** (e.g. promoters and leaders), more individual autonomy especially of women and generally empowerment through new economic resources and knowledge to share with the community. However, these aspects of self esteem, empowerment and autonomy on the personal level, which are of utmost importance to keep change processes ongoing in the long term, are difficult to measure and are therefore left to marginal analyses, not implemented with the depth they require.

CONCLUSION

This literature review aimed at outlining the characteristics of *in situ* conservation in the Andean regions of Bolivia, Ecuador, and Peru, in order to understand the main activities carried out and how their success was measured. Some difficulties were encountered while writing up the literature review connected to the task of retrieving reports and information on the projects, and to the fact that the analysis was constrained by the lack of systematization of projects' experiences.

From this first analysis we reckon that the success of projects partly depends on how their objectives and therefore implementation fit in a specific ecosystem, culture and dynamics of the communities. Despite the lack of significant results in terms of income, projects can be successful in improving nutrition and diets; the soil fertility and health; awareness on sustainability issues, maintaining and improving the relation between communities and their natural resources; and the recovery and increase of Andean agrobiodiversity.

In situ conservation in the Andes is carried out by farmers in remote areas with poor economic, soil and water resources. They keep diversity alive and support its evolution through many traditional forms of cultivation, inherited or rescued from ancestors. Among the most important aspects of the conservation of agrtobiodiversity in the region, is that the understanding of the Andean worldview, relationships and boundaries is a condition *sine qua non* for the success of conservation projects. During all stages of the design and implementation of activities, generation and transfer of technology, and the promotion and dissemination, farmer participation should be active and voluntary, so that these activities have serious prospects of full acceptance by communities and larger adoption. Also, aspects that improve the projects'

relationship with institutions, local organizations, and local government involvement in the activities should be strengthened.

Finally, interesting interlinks between indicators of diversity and livelihood results support the hypothesis that the two domains are strongly intertwined, and that projects outlining this relationship have great probability of achieving relevant outcomes.

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ANNEX I – TABLES

Table 1: List of projects directly aimed at *In situ* conservation

Project Title	Target	Implementing Organization	Main Donor	Location
Proyecto Integral Las Huaconas (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	Andean tubers: oca, ulluco, mashwa, arracacha, mauka, yam bean	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Departamento Nacional de Recursos Fitogenéticos y Biotecnología (DENAREF) CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	Las Huaconas, Chimborazo Ecuador
Proyecto Integral Candelaria (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	Andean tubers: Papa (Solanum andigena, S. stenotomum, S. ajanhuiri, S. phureja), oca, ulluco, mashwa	Promoción e Investigación de Productos Andinos (PROINPA) Asociación de Productores de Tubérculos Andinos de Candelaria (APROTAC) Programa de Alimentos y Productos Naturales (PAPN-UMSS) San Simon University Proyecto de Mercadeo y Comercialización de los Tubérculos Andinos (PROMETAS-UMSS) CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	Alto San Isidro, Primera Candelaria, Rodeo Alto and Tabla Mayu communities, Candelaria, Cochabamba Department, Bolivia

Project Title	Target	Implementing Organization	Main Donor	Location
Proyecto Integral Altiplano (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	Andean tubers: oca, ulluco, mashwa	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Promoción e Investigación de Productos Andinos (PROINPA) CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	Yunguyo, Puno Region, Perú Copacabana-Escoma, Región de los kallawayas, La Paz Department, Bolivia
Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	Andean roots: Arracacha	CONDESAN IESE – UMSS (Instituto de Estudios Sociales y Económicos de la Universidad Mayor de San Simón)-Bolivia INIAP (Intituto Nacional de Investigación Agropecuaria) ESCAES (Escuela Campesina de Educación y Salud) UNC (Universidad Nacional de Cajamarca), Peru CIP (Centro Internacional de la Papa)	SDC (Suisse Agency for Development and Cooperation)	San Juan de la Miel, La Paz Department, Bolivia San José de Minas, Quito, Pichincha Province, Ecuador Sucse, Cajamarca Region, Perú
Native Potato: improved production of native potatoes in the Andean highlands of Peru	Andean tubers:	Intermediate Technology Development Group (ITDG), Peru Instituto Nacional de Innovacion Agraria (INIA), Peru Central de Autodefensa de Pataccalasaya (CAP), Peru	McKnight Foundation	Quechua and Aymara communities, Cusco Region, Peru
Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands	Andean tubers: oca, ulluco, potato	CIP (Centro Internacional de la Papa) University of Cuzco/CRIBA	McKnight Foundation	Cusco, Cusco Region, Peru
Uso, manejo y conservación in situ de tres variedades locales de papa en el Austro Ecuatoriano	Andean tubers: papa	CEDIR	UNDP	Provincia Azuay, Provinica Cañar, Ecuador
Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica, Peru	Andean Tubers	Grupo Yanapai, Peru Federación de Mujeres Campesinas de Yauli (FEMUCAY), Peru Federación de Comunidades Chopccas-Yauli, Huancavelica, Peru National Agricultural Research Institute (INIAP) CIP (Centro Internacional de la Papa)	McKnight Foundation	Yauli and Pacara districts, Huancavelica, Peru
Potato moth: biopesticide development and diffusion of potato moths. Integrated management to strengthen food security in the Ecuadorian Andes	Andean Tubers	Pontificia Universidad Católica del Ecuador (PUCE), Ecuador Institut de recherche por le développement (IRD), Ecuador Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP)	McKnight Foundation	Guntuz Community, Riobamba Canton, Chimborazo Province, Ecuador
Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio	Andean roots: leafcup, arracacha, ajipa and yam bean	Promoción e Investigación de Productos Andinos (PROINPA) Asociación de Productores y Procesadores Ecológicos de	Fundacion PUMA via Iniciativa para la America (EIA)	Colomi, Chapare Province, Cochabamba Region, Bolivia

Project Title	Target	Implementing Organization	Main Donor	Location
de Colomi, provincia Chapare – Cochabamba		Agrodiversidad (APyPA)		
IFAD NUS – Bolivia/Peru	Andean grains: Quinoa Cañihua Amaranth	Bioversity International Promoción e Investigación de Productos Andinos (PROINPA) CIRNMA (Perú - Ministry of Agriculture)	IFAD	Santiago de Okola Coromata Media Cuevas Canadas Mojotorillo Bolivia Cieneguillas Corisuyo Auquiorko Ocoruru, Peru
Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA	Andean grains: Cañahua Quinoa	PROINPA Foundation Subsistema de Granos Altoandinos del SINARGEAA Universidad Mayor de San Andrés – UMSA Universidad Técnica de Oruro – UTO Centro de Investigación y Producción Comunal de Irpani - CIPROCOM.	Bolivian Government - Sistema Boliviano de Tecnología Agropecuaria (SIBTA)	La Paz: Coromata Media Chauhira Chico Jalsuri, Colina Patarani, San Pedro y San Pablo, Rosapata Erbenkalla, Kalla Arriba, Tacaca Corpa, Tiahuanacu, Titijoni, Cachilaya, Cutusuma, Cutusuma Alta, Igachi, Kealluma, Río Grande, Chojñacollo, Avicaya, Cariquina Grande, Jutilaya Chiaruyo, Pomposillo Pusucani, Asunción de Huancarama Iñacamaya, San José de Llanga, Vitu Calacachi, Salviani, Ayamaya Oruro: Tola Phujru, Tika Noka, Quillacas, Sullka Tunka, Chuquichuru, Condoriri, Irpani Potosí: Chacala, Sajsi Cochabamba: Llaytani. Bolivia
Desarrollo Sostenible de Quinua Orgánica en el Perú	Andean grains: Quinoa	Instituto Nacional de Investigación y Extensión Agraria (INIEA) Universidad Nacional del Altiplano (UNAP) Asociación Agroindustrial de Granos Andinos (ASAIGA)	Scanagri/NIRAS	Cabana, Puno, Lima, and Cusco, Peru
Sustainable production of quinoa: a neglected food crop in the Andean region	Andean grains: Quinoa	Promoción e Investigación de Productos Andinos (PROINPA)	McKnight Foundation	Salar de Uyuni, Potosi Department, Bolivia
Lupin/ Quinoa: Sustainable production systems to guarantee food security in impoverished communities in the province of Cotopaxi, Ecuador	Ansean grains: Lupin Quinoa	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Social Development Committee "Path to Progress" (CODESOCP)	McKnight Foundation	Saquisili, Cotopaxi Province, Ecuador
Conservación complementaria *ex situ - in situ* de especies silvestres de quinoa y cañihua en Bolivia	Ansean grains: Quinoa Cañihua	Promoción e Investigación de Productos Andinos (PROINPA) Fundación Amigos de la Naturaleza	Global Environmental Facility (GEF) Bioversity International (IPGRI)	Cariquina Grande (Provincia Camacho), Cachilaya (Provincia Los Andes), Titijoni (Provincia Ingavi) y Coromata Media (Provincia Omasuyos). La Paz Department, Bolivia

Project Title	Target	Implementing Organization	Main Donor	Location
Programa de apoyo a la cadena quinoa altiplano sur	Ansean grains: Quinoa	Fundación Autapo	Dutch Embassy	Altiplano Sur, Potosi, Bolivia
Green manure and legumes: integrating agronomic and health research for improving the production of food and diets in marginal areas of Northern Potosi	Andean Legumes	World Neighbours	McKnight Foundation	Municipalities of Sacaca, San Pedro de Buenavista and Acasio, Potosi Department, Bolivia
Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)	Andean Legumes Grass species	Manejo Comunitario de Recursos Naturales (MACRENA) World Neighbours	McKnight Foundation	Ibarra, Otavalo and Cotacachi, Carchi and Imbabura provinces, Ecuador
In-Situ Conservation of Native Cultivars and Their Wild Relatives	FRUITS: camu-camu, granadilla GRAINS: cañihua, maize, Quinoa LEGUMES: lima beans ROOTS: arracacha, maca, sweet potato (yuca), mauka TUBERS: Papa	Instituto Nacional de Investigación y Tecnología Agraria (INIA)	United nations Development Programme (UNDP) Global Environmental Facility (GEF) - Small Grant Programme	SIERRA NORTE (Cajamarca), SELVA ALTA (Loreto), SELVA BAJA (San Martín), SIERRA CENTRAL (Huancavelica y Junín), COSTA CENTRAL (Ica y Lima) y SIERRA CENTRO SUR (Ayacucho), Peru
Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el Noroccidente de Pichincha	Forest Ecosystem	Fundación Rainforest Rescue – FURARE UNDP	Global Environmental Facility (GEF)	San Miguel de los Bancos, Pichincha, Ecuador
Conservation of Biodiversity in Pastaza	Palm trees, fruit trees, timber and medicinal plants	Instituto Quichua de Biotecnología Sacha Supai Global Environmental Facility (GEF) Inter-institutional Network of Specialists in Environmental Management	Global Environmental Facility (GEF) Co-financing	Quichua communities of Yana Yacu, Nina Amarun and Lorocachi, Pastaza Province, Ecuador
Conservacion complementaria y uso sostenible de cultivos subutilizados en Ecuador, rescate, promocion y uso de recursos fitogeneticos interandinos de Ecuador	Neglected and underutilized species (NUS): tree tomato, cucurbitaceas (sambo and banana squash (zapallo)), banana passionfruit, granadilla and chili peppers	Instituto Nacional de Investigaciones Agropecuarias (INIAP) United States Department of Agriculture (USDA) Unión de Organizaciones de Campesinos de Cotacachi (UNORCAC) Unión para la Cooperación y Desarrollo de los Pueblos (UCODEP) Bioversity International (IPGRI)	FAO	Cotacachi, Imbabura Province, Ecuador
Conservación y manejo de la agrobiodiversidad en la cordillera de El Cóndor	Neglected and underutilized species (NUS)	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Departamento Nacional de Recursos Fitogenéticos y Biotecnología (DENAREF)	SDC (Suisse Agency for Development and Cooperation)	Municipios de San Juan Bosco, Limón y Gualaquiza, Morona Santiago Province, Ecuador
Seed systems. The biological foundation of food security in the Andes	Andean crops	World Neghbours, Ecuador DIPEIB-Chimborazo, Ecuador DIPEIB-Cotopaxi, Ecuador FUNPRODIB, Ecuador Wageningen University and Research Centre, Netherlands	McKnight Foundation	Bolivar, Chimoborazo, and Cotopaxi Province, Ecuador

Project Title	Target	Implementing Organization	Main Donor	Location
Removing Obstacles to Direct Private-Sector Participation in In-situ Biodiversity Conservation		Protection of the Environment Tarija (PROMETA) World Bank The Nature Conservancy Servicio Nacional de Areas Protegidas (SERNAP)	Global Environmental Facility (GEF)	Bolivia

Table 2: Description of projects' expected outcomes, outputs, and output indicators (next page)

Project	**Resultados Esperados** *(Los resultados son los efectos probables o logrados a corto y mediano plazo-o los cambios producidos por los productos de una intervención)*	**Productos Generados** *(Las salidas son los productos, bienes de capital y servicios que representan los resultados tangibles, medibles e inmediatos de la intervención)*	**Indicadores de producto** *(Los indicadores de producto miden y verifican la producción de los productos, es decir, los bienes y servicios que son producidos por las entradas. Tienen atributos de cantidad, calidad y de tiempo)*	
			Biodiversidad	**Bienestar**
Proyecto Integral Las Huaconas (Programa Colaborativo Biodiversidad De Raíces Y Tubérculos Andinos (RTAs))*	Manejo *in situ* de RTAs y preservación de recursos naturales	1. Identificación de microcentros de diversidad y conservación *in situ* de RTAs 2. Evaluación y promoción de varias especies de RTAs en sistemas forestales para manejo y conservación de suelos en cuatro comunidades de la Cuenca alta del río Pastaza. 3. Manejo integral de la biodiversidad de RTAs en Ecuador	1.1 Microcentro de diversidad y conservación in-situ de RTAs identificado 2.1 Numero de ferias de Conservación de Semillas organizadas 3.1 Número de entradas de melloco, oca, mashua, jícama, miso y zanahoria blanca duplicadas in vitro 3.2 Número de entradas de RTAs de cultivares locales como de especies silvestres mantenidas en campo	
	Producción y distribución de semilla de calidad	1. Producción y distribución de semilla de melloco blanco jaspeado y conformación de núcleos semilleros 2. Limpieza viral a través de termoterapia más cultivo de meristemas en clones promisorios de mayor aceptabilidad de melloco y zanahoria blanca	1.1 Numero de variedades en el campo identificadas 1.2 Investigación participativa sobre criterios de selección de los agricultores llevada a cabo 1.3 Numero de morfotipos más aceptables seleccionados 1.4 Numero de ferias de semillas organizadas para la distribución de semillas de calidad 2.1 Cuantidad de material limpiado propagado	1.1 Numero de núcleos semilleros formados
	Aplicaciones agroindustriales y producción artesanal de elaborados de RTAs	1. Aplicaciones agroindustriales en base a parámetros importantes identificados en RTAs 2. Inventario, desarrollo y transferencia de tecnología para la producción artesanal de elaborados a partir de zanahoria blanca, melloco y oca		1.1 Tecnología para melloco y zanahoria blanca precocidos y congelados desarrolladla 2.1 Número de mujeres en la producción de elaborados artesanales aumentado 2.2 Número de mujeres que participaron a eventos de capacitación 2.3 Número de recetas elaboradas 2.4 Tecnología para la producción de artesanías de zanahoria blanca, oca y melloco desarrollada e implementada

Project	**Resultados Esperados** *(Los resultados son los efectos probables o logrados a corto y mediano plazo-o los cambios producidos por los productos de una intervención)*	**Productos Generados** *(Las salidas son los productos, bienes de capital y servicios que representan los resultados tangibles, medibles e inmediatos de la intervención)*	**Indicadores de producto** *(Los indicadores de producto miden y verifican la producción de los productos, es decir, los bienes y servicios que son producidos por las entradas. Tienen atributos de cantidad, calidad y de tiempo)*	
			Biodiversidad	**Bienestar**
	Investigación de mercados y promoción del consumo de RTA.	1. Caracterización y acuerdo con puntos de venta de melloco en Quito, enfocando las oportunidades y limitaciones de abastecimiento desde Las Huaconas		1.1 Usos productivos y nutricionales de melloco y zanahoria blanca identificados 1.2 Numero de promotores formados 1.3 Cursos, libros de cocina 1.4 Programas de televisión sobre los RTAs y sus usos 1.5 Numero de acuerdos con puntos de venta en Quito
	Transferencia de tecnología y capacitación	1. Validación, transferencia de tecnología y formación sobre los RTAs		1.1 Mejores prácticas de procesamiento identificadas 1.2 Numero de eventos de capacitación organizados 1.3 Número de agricultores que participaron en los eventos de capacitación 1.4 Autodibujos, programas de radio, archivos fotográficos, material escrito
Proyecto Integral Candelaria (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))*	Desarrollo de estrategias de producción, manejo y conservación de la biodiversidad de RTAs.	1. Identificación de variedades locales de tubérculos andinos 2. Revalorización de variedades nativas de papa y oca con agricultores de Candelaria 3. Validación de circuitos locales de semilla (var. imilla blanca) dentro del sistema de producción de Candelaria 4. Rendimiento potencial de papa nativa, papalisa, oca e isaño, en la localidad de Candelaria (prov. Chapare-Cochabamba)	1.1 Numero de cultivares locales identificados por sus nombres locales, sus características fenotípicas así como por los conocimientos asociados a su utilización 2.1 Germoplasma comunal de tubérculos andinos establecido 2.2 Ferias de semillas y exposición de entradas de tubérculos andinos	3.1 Estudio sobre los criterios del agricultor en el movimiento de semilla en los circuitos locales 4.1 Comportamiento de 8 variedades seleccionadas evaluado
	Revalorización de tecnologías tradicionales e implementación de nuevas tecnologías para el procesamiento	1. Aplicación, validación y evaluación de tecnologías tradicionales mejoradas en la elaboración de chuños 2. Caracterización de la oferta de productos procesados tradicionalmente (chuños) en Candelaria y en el mercado cochabambino 3. Diseño y difusión de un paquete educativo alimentario y estrategia de promoción y difusión a utilizarse en la zona de Candelaria 4. Investigación de mercado para papalisa deshidratada en hojuelas en las ciudades de Cochabamba, La Paz y Santa Cruz		1.1 Estudio sobre las técnicas artesanales de procesamiento de oca 1.2 Estudio comparativo sobre proceso tradicional y mejoras propuestas 2.1 Estudio de los volúmenes de comercialización de chuño en la ciudad de Cochabamba y del volumen potencial ofertado por la región de Candelaria al mercado urbano 3.1 Número de mujeres y niños capacidades para evaluar mezclas seleccionadas en base a cereales– leguminosa– tubérculo 4.1 Investigación de mercado efectuada en las tres

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			Biodiversidad	**Bienestar**
		5. Desarrollo de tecnologías para el procesamiento de isaño		ciudades más importantes de Bolivia 5.1 Técnica del secador solar desarrolladla
	Promoción y mercadeo de tubérculos andinos	1. Estrategia para un eficiente sistema de comercialización: los sistemas de almacenamiento como estrategia para mejorar la comercialización de oca y papalisa de Candelaria 2. Estrategias de promoción y mercadeo de oca y papalisa en supermercados de Cochabamba		1.1 Observaciones directas, mediciones de campo y encuestas complementarias sobre los sistemas tradicionales de almacenamiento 1.2 Almacenes mejorados de oca y papalisa 2.1 Observaciones directas y entrevistas abiertas a comerciantes mayoristas y productores de la zona de Candelaria 2.2 Encuestas al consumidor 2.4 Estrategia de promoción del consumo y mercadeo en los supermercados de mayor categoría diseñada 2.5 Cuantificación de ingresos aumentados para los campesinos 2.6 Comité de Investigación Agrícola Local (CIAL) Primera Candelaria y Asociación de Productores de Tubérculos Andinos Primera Candelaria (APROTAC) creados
Proyecto Integral Altiplano (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))*	Dinámica en los microcentros de conservación *in situ* de tubérculos andinos	1. Dinámica de conservación *In Situ* de RTAs en el microcentro de Yunguyo 2. Promoción y difusión del consumo de RTAs para mejorar la nutrición infantil en el altiplano 3. Manejo de la biodiversidad *In Situ* en cuatro ayllus de la Reserva Nacional de Ulla Ulla	1.1 Estudio sobre familias, agricultores y ferias 1.2 Numero de variedades identificadas y clasificadas 1.3 Estudio de la dinámica de conservación en las familias 3.1 Encuestas sobre la evolución de la conservación de agrobiodiversidad	1.4 Numero de ensayos de mezcla de oca para determinar los rendimientos 2.1 Encuesta de consumo para seleccionar los alimentos mas aceptados 2.2 Estudio sobre la oferta y demanda de la biodiversidad de RTAs en los mercados locales 2.3 Número de cursos–talleres para la elaboración de mermeladas 2.4 Número de recetas formuladas 2.5 Numero de campañas educativas para el uso de tubérculos andinos como alimentación complementaria 2.6 Numero de talleres participativos de autodiagnóstico y priorización

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	Determinación de flujos de semilla de RTAs en la zona circunlacustre del Lago Titicaca. Copacabana – Escoma, Bolivia	1 Producción de semilla de calidad de tubérculos andinos en el altiplano boliviano 2 Determinación de un microcentro de conservación	1.1 Cuantidad de semilla limpiada devuelta a su zona de origen 1.2 Cuantidad de semilla multiplicada y producida a mayor escala 2.1 Inventario de la variabilidad en la zona: ferias, familias productoras	
	Conservation and use of RTAs in the región of Los Kallawayas	1 Consolidación de los flujos de semilla bajo gestión de las comunidades 2 Promoción del procesamiento de tubérculos	1.1 Numero de variedades limpias de virus evaluadas, controladas y devueltas 1.2 Estudio de control sobre las variedades distribuidas a las familias	1.3 Numero de responsables capacitados en dosificaciones de fungicidas, registro y evaluación de siembras, desarrollo y cosecha 2.1 Pruebas para mejorar la calidad y presentación del producto 2.2 Ensayos para la mejora de productos procesados
Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))*	Sintetizar y generar una metodología, válida para el desarrollo de agroindustrias tradicionales de los Andes.	1. Marco metodológico aplicable al desarrollo de AIR 2. Metodología desarrollada		1.1 Informes sobre el marco metodológico para la realización de agroindustrias rurales (AIR) 2.1 Informe sobre la metodología
	Identificar en las zonas piloto de CONDESAN agroindustrias tradicionales o actividades promisorias en marcha factibles de ser potenciadas.	1 Criterios y lineamientos para identificación de actividades promisorias 2 Proyectos desarrollados para mejorar o desarrollar AIR		1.1 Informes de taller 2.1 Número de proyectos
	Fortalecer las capacidades institucionales de los socios a nivel de los países andinos en aspectos técnicos y sociales relacionados con el desarrollo de agroindustrias	1 Necesidades de capacitación identificadas 2 Talleres regionales 3 Profesionales de instituciones socias de CONDESAN mejor capacitados		1.1 Numero de informes 2.1 Numero de talleres 3.1 Número de profesionales capacitados
	Mejorar la competitividad de la agroindustria rural del "Rallado de Arracacha", en Sucse – Cajamarca – Perú.	1 Diagnóstico socioeconómico sobre la comunidad de Sucse 2 Oferta, demanda y tecnología del rallado caracterizados 3 Productos con calidad competitiva 4 Nuevos mercados para el desarrollo		1.1 Base de Datos con indicadores socioeconómicos 1.2 Organización del trabajo con definición de roles. 2.1 Numero de informes con oferta y demanda cuantificados y limitantes de proceso y mercados identificados 3.1 Tecnologías mejoradas: menores costos, calidad sanitaria según normas. 4.1 Existen nuevos puntos de venta, fuera de los mercados tradicionales. 4.2 Se ha incrementado la utilidad por venta

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			Biodiversidad	**Bienestar**
				4.3 Producto con imagen
	Mejorar la competitividad comercial de la arracacha fresca en San José de Minas (Ecuador), San Juan de La Miel (Bolivia) y Sucse (Perú)	1 Mercado en fresco caracterizado 2 Limitantes de poscosecha (Identificados – cuantificado) 3 Desarrollo de alternativas tecnológicas 4 Promoción y difusión		1.1 Desarrollo actual y potencial de los mercados cuantificado 1.2 Estudio sobre segmentación del mercado y preferencias en presentación del producto 2.1 Numero de informes 3.1 Propuesta para disminuir pérdidas: empaque, técnicas de manipuleo, almacenamiento 4.1 Manuales técnicos sobre: tecnología de poscosecha de arracacha, rallado de arracacha. 4.2 Página Web sobre lecciones aprendidas, sobre mercadeo de productos de agroindustrias rurales, competitividad de AIR
	Fortalecer las capacidades locales mediante la formación de líderes campesinos	1 Diagnóstico de necesidades locales de capacitación 2 Eventos de capacitación organizadas 3 Hombres y mujeres de ámbitos intervenidos capacitados en organización, gestión, tecnología y mercado 4 Formación de líderes locales 5 Sistematización y difusión de resultados		1.1 Numero de informes 2.1 N/A 3.1 Porcentual de la población intervenida 4.1 Numero de líderes formados 4.2 Manuales
Native Potato: improved production of native potatoes in the Andean highlands of Peru**	Determinar y difundir las tecnologías agronómicas más apropiadas que permitan incrementar la calidad y productividad de las variedades y ecotipos de papa nativa identificadas en 12 comunidades Quechuas altoandinas de la provincia de Canchis, Cusco	1. Investigadores y comuneros han identificado, caracterizado y valorado las diferentes variedades y ecotipos de papa nativa de 12 comunidades campesinas del ámbito del proyecto 2. Investigadores y comuneros han estudiado, mejorado, validado y difundido a 600 familias campesinas labores culturales adecuadas, prácticas sanitarias oportunas y técnicas de almacenamiento apropiadas para las variedades y ecotipos de papas nativas identificadas	1.1 Numero de variedades de papas nativas caracterizadas morfologicamente 1.2 Numero de variedades de papas nativas identificadas por los campesinos productores de papas nativas en otras comunidades, y caracterizadas de acuerdo a criterios locales 1.3 Diagnóstico de los problemas que afectan a los cultivos y a los agricultores 1.4 Numero de experimentos campesinos con los agricultores campesinos 1.5 Cuantidad distribuida de semilla adquirida de varias comunidades campesinas remotas	

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			Biodiversidad	**Bienestar**
	Establecer sistemas locales sostenibles de provisión de semillas y asistencia técnica que permitan incrementar la calidad y los rendimientos de los cultivares de papa nativa a los pequeños productores de 12 comunidades Quechuas altoandinas de la provincia de Canchis, Cusco	1. Las comunidades campesinas del ámbito del proyecto han implementado y gestionan un fondo rotatorio de semillas de papa nativa y semilleros para la producción sostenible de las mismas 2. Líderes tecnológicos campesinos han establecido un sistema local de provisión de asistencia técnica culturalmente aceptado y económicamente atractivo para la mejor producción de papa nativa	1.1 Cuantidad de semilla adquirida entregada a las familias productoras de papa nativa para siembra y multiplicación como fondo rotatorio 1.2 Cuantidad de semilla compartida entre agricultores de diversas comunidades durante varias campañas	2.1 Número de agricultores campesinos formados en calidad de expertos (“kamayoq”) 2.2 Numero de talleres de las ECAs, pasantías, días de campo 2.3 Número de cursos sobre las Escuelas de Campo y el cultivo de papas nativas dirigidos a los lideres y agricultores campesinos
	Sentar las bases para el crecimiento del mercado de papas nativas en el país identificando opciones de mercado, probando esquemas de permitan una adecuada comercialización y difundiendo los resultados obtenidos	1. Pequeños productores de papa nativa han identificado nuevas oportunidades de mercados de papa nativa y han establecido los canales adecuados para comercializar su producción 2. Las organizaciones participantes han documentado detalladamente la experiencia, el modelo de intervención y las lecciones con el propósito de promover una réplica a mayor escala		1.1 Estudio sobre la cadena productiva de las papas nativas 1.2 Numero de talleres para los actores de la cadena productiva de papas nativas 1.3 Numero de talleres sobre la cultura emprendedora 2.1 Documentos de diseminación de las actividades del proyecto 2.2 Reportajes sobre varios aspectos del cultivo de las papas nativas 2.3 Programas televisivos y radiales
Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands	To strengthen the factors that contribute to a sustainable conservation and utilization of oca, ulluco, mashua and Andean potatoes without damaging environment	1. Documentacion de los cultivares / morfotipos cultivados por los agricultores en cada comunidad rural y obtener información sobre su distribución geográfica 2. Determinacion del flujo de tubérculos de semilla en la ecorregión 3. Documentacion de los conocimientos de los agricultores sobre el manejo del complejo de los tubérculos andinos 4. Mejoramento de las tecnologías de post cosecha y de almacenamiento 5. Identificación de los obstáculos a la comercialización 6. Inventario de la variabilidad genética mediante marcadores moleculares 7. Determinación de glucosinolatos en mashua	1.1 Numero de morfotipos del complejo de los tubérculos andinos identificados 1.2 Numero de morfotipos homologados con la colección de campo gestionada por el Centro Internacional de la Papa (CIP) en Huancayo 2.3 Estudio sobre el flujo de semillas de los tubérculos dentro y entre los pueblos	3.1 Numero de grupos de trabajo de agricultores voluntarios establecidos 4.2 Numero de experimentos para el mejoramento de los sistemas de almacenamiento tradicionales 4.3 Numero de almacenes nuevas construidas 4.4 Numero de pozos para absorber los tubérculos Andinos mejorados 5.1 Numero de variedades de papa andina identificadas como generadores de ingresos 5.2 Analisis de los precios reales de mercado 5.3 Analisis de las barreras de mercado (oferta-demanda) 6.1 Analisis molecular en laboratorio de las accesiones de papa y oca 7.1 Numero de glucosinolatos identificados y cuantificados en cultivos y accesiones silvestres

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			Biodiversidad	**Bienestar**
				de mashua
	To develop strategies for integrated management of oca, ulluco, and Andean potato weevils as one system	1. Determincaion de la taxonomía de los gorgojos 2. Determinacino de la biología y del comportamiento de gorgojos de oca y olluco 3. Manejo integrado de los gorgojos 4. Difusión de conocimientos y capacitación para promover la conservación de la agro-biodiversidad y la seguridad alimentaria	1.1 Taxonomia de gorgojos estudiada a través de muestras de campo y especímenes de museo 2.1 Estudio diagnóstico del estado de las plagas de oca, olluco, mashua en las aldeas de P'oques, Chumpi y Sayllafaya 2.2 Nematodos entomopatógenos Heterorhabditis investigados 2.3 Encuesta participativa para los nematodos en la comunidad de Picol	3.1 Número de estudiantes y profesionales formados en Perú y Davis 3.2 Numero de talleres para los agricultores sobre la gestión integrada de los tubérculos andinos 4.1 Numero de escolares capacitados durante la siembra y cosecha en la identificación de las principales plagas de los tubérculos andinos 4.2 Numero de agricultores que participaron a escuelas de campo (ECAs) 4.3 Numero de organizaciones y asociaciones de productores establecidas 4.4 Programas de radio en quechua 4.5 Numero de eventos participados 4.6 Numero de seminarios sobre la taxonomía de los gorgojos, los tubérculos andinos, y la conservación *in situ*
Uso, manejo y conservación *in situ* de tres variedades locales de papa en el Austro Ecuatoriano	Motivar y apoyar a pequeños y medianos agricultores de Azuay y Cañar para la conservación de la diversidad de papa existente en la región, en función de revalorizar dicha diversidad para múltiples usos, entre otros para aportar en la alimentación humana	1. Promocionar la conformación y/o fortalecimiento de grupos semilleros/conservadores del germoplasma 2. Realizar un seguimiento técnico de los cultivos de germoplasma y aplicación de metodología de selección de semillas locales con fines demostrativos 3. Seguimiento técnico del cultivo y demostración de técnicas de conservación y producción. 4. Mejoramiento de los sistemas de almacenamiento	2.1 Numero de variedades de papas locales recolectadas 2.2 Numero de parcelas para la caracterización y multiplicación de cultivos del germoplasma recolectado en Azuay, Cañar.	1.1 Numero de grupos conformados 1.2 Número de personas capacitadas en el proceso de manejo de las semillas y de la biodiversidad local, en papa 3.1 Días de campo demostrativos a los potenciales usuarios de semillas locales (campesinos) 3.2 Talleres de promoción del manejo y conservación de la semilla local 3.3 Parcelas demostrativas en sectores potenciales usuarios de las semillas de papa. 4.1 Numero de silos verdeadores de papa construidos 4.2 Locales para almacenamiento de semillas de papa construidos
Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi, provincia	Contribuir a la conservación de la biodiversidad de raíces andinas (yacón, arracacha, ajipa y achira) por el mejoramiento de la producción y del valor agregado de su	1. Aplicación de la agricultura orgánica en las comunidades indígenas para fortalecer la producción de las raíces andinas 2. Fortalecimiento de los procesos de transformación 3. Promoción y comercialización de raíces	1.1 Planes agro ecológicos 1.2 Numero de variedades cultivadas ecológicamente por los socios ACEPLO 1.3 Cuantificación del incremento de la producción 1.4 Cuantidad de semilla recuperada y	2.1 Asociación de Productores y Procesadores Ecológicos de Agro biodiversidad creada 2.2 Planta Comunal de Procesamiento de Raíces Andinas instalada 2.3 Número de mujeres agricultoras capacitadas para utilizar la planta

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Chapare – Cochabamba	comercialización	andinas	redistribuida a las comunidades	3.1 Numero de marcas comerciales creadas 3.2 Numero de productos comercializados 3.3 Numero de productos certificados como orgánicos
Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica, Peru**	Recuperar la agrobiodiversidad con énfasis en papa para mejorar el manejo de los cultivos, los pastos, para mejorar la productividad y la dieta nutricional de las familias campesinas	1. Colección en ferias de semillas y bancos comunales de la agrobiodiversidad de tubérculos andinos 2. Manejo Comunal del Germoplasma de papa nativa 3. Comparativo de producción de semillas de papa nativa de selección positiva v/s selección tradicional 4. Evaluación del incremento de la producción de papa nativa, mediante preparados orgánicos con insumos locales 5. Repatriación de papas nativas 6. Repoblamiento de Germoplasma de tubérculos y granos andinos 7. Selección participativa de líneas promisorias de haba, cebada, quinua y trigo con resistencia a enfermedades 8. Recuperación del conocimiento sobre costumbres, usos, tecnología y conservación de la agrobiodiversidad 9. Evaluación participativa de la situación de praderas y colección de pastos apetecibles para el ganado 10. Establecimiento y caracterización de pastos forrajeros 11. Pruebas de adaptación de variedades de alfalfa con incorporación de ceniza y cal 12. Establecimiento de pasturas con asociación múltiple 13. Implementación de huertos orgánicos familiares 14. Sistema de crianzas mejorados de cuyes y gallinas	1.1 Cuantidad de semilla recogida en ferias de biodiversidad 2.1 Banco comunal de papas nativas 3.1 Numero de ensayos para mejorar la calidad 4.1 Numero de ensayos para incrementar la producción de papa nativa 5.1 Cuantidad de variedades retornadas 6.1 Programa de Repoblamiento 7.1 Líneas promisorias de haba, cebada, quinua y trigo con resistencia a enfermedades seleccionadas 8.1 Base de datos que registra las diferentes tecnologías en uso 9.1 Inventario de especies forrajeras y no forrajeras 10.1 Numero de ensayos comparativos 11.1 Investigación participativa de producción de semilla vicia con tutores 12.1 Campos de ensayo 13.1 Numero de huertos orgánicos familiares	14.1 Número de proyectos 15.1 Numero de talleres y festivales de Cocina Andina 16.1 Campañas de información, promoción y consumo de los cultivos andinos

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			Biodiversidad	**Bienestar**
		15. Campañas y talleres de sensibilización de prácticas saludables de alimentación con cultivos andinos 16. Capacitación en la elaboración de alimentos con cultivos andinos con el propósito de mejorar el nivel de nutrición familiar		
	Implementar prácticas de manejo integrado de las principales plagas y enfermedades en los cultivos, con énfasis en papa y tubérculos andinos	1. Manejo integrado de plagas 2. Investigación en uso de extractos vegetales y minerales en el manejo de las plagas más importantes de los cultivos principales en las Comunidades Chopccas 3. Implementación de dos Escuelas de Campo de Agricultores en Manejo Integrado del Ganado	1.1 Investigación participativa para validar y/o desarrollar alternativas de control de plagas 2.1 Capacitación e investigación participativa en la elaboración y usos de biofertilizantes líquidos y Biopesticidas en el manejo de plagas 2.2 Diagnostico de la Calidad de la semilla local de papa(Mapeo) 2.3 Investigación participativa de manejo de las granizadas	3.1 Numero de promotores conservacionistas de la agrobiodiversidad formados 3.2 Numero de promotores capacitados en manejo integrado del ganado (ECAs)
	Mejorar la conservación y fertilidad del suelo mediante técnicas modernas y tradicionales que optimicen el uso de recursos locales	1. Estudio de calidad de los suelos en la comunidad chopcca	1.1 Clasificación participativa y prácticas de recuperación de suelos 1.2 Investigación en brechas de rendimiento 1.3 Comparativo de sistemas de labranza en el cultivo de papa y tarhui 1.4 Numero de viveros con especies nativas y exóticas	
	Fortalecer las capacidades, habilidades y destrezas de las familias campesinas en la generación de alternativas traduciendo innovaciones tecnológicas con prácticas locales para el mejoramiento del sistema de producción	1. Fortalecimiento de las Directivas de las Organizaciones de Mujeres y Comunales que dirigen los trabajos de Investigación en sus bases	1.1 Pasantias para visistar otras experiencas exitosas	1.2 Numero de promotoras campesinas formadas en nutrición 1.3 Numero de promotores campesinos formados en gestión comunal 1.4 Reuniones de planificación y evaluación entre instituciones y organizaciones participantes en el proyecto

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			Biodiversidad	**Bienestar**
	Facilitar el Intercambio de experiencias, apoyo mutuo, y aprendizaje colectivo en la Región Andina y Comunidades de los Andes del Perú	1. Intercambio de experiencias		1.1 Número de participantes a eventos de capacitación 1.2 Visita a experiencias exitosas en agricultura alternativa 1.3 Participación en el congreso de cultivos Andinos
Potato moth: biopesticide development and diffusion of potato moths. Integrated management to strengthen food security in the Ecuadorian Andes	Desarrollo del bioplaguicida	1 Recolección de material biológico 2 Multiplicación y caracterización de virus Optimización producción masiva de virus 3 Bio-ensayos de laboratorio 4 Evaluaciones de bioplaguicidas virales		1.1 Lista de aislamientos virales 2.1 Diagnostico de la presencia de probables virus en varias de las muestras analizadas 2.2 Estudio epidemiológico sobre material biológico 2.3 Borrador de la tesis de licenciatura 2.4 Presentación en congreso Organización Internacional de Lucha Biológica (OILB) 2.1 Metodologías de multiplicación, obtención y almacenamiento de dos cepas de virus 2.2 Técnicas de cría masiva de Tecia solanivora 2.3 Materiales inertes para la formulación del bioplaguicida identificados 4.1 Publicaciones y comunicaciones ,tesis 4.1 Estudio sobre la eficiencia del bioplaguicida 4.2 Tesis de pre-grado 4.3 Integrantes de escuelas de campo capacitados 4.4 Técnicos de almacenes agrícolas capacitados 4.5 Niños capacitados en cría masiva, formulación y aplicación de un bioinsecticida viral en tubérculos semillas 4.6 Visitas a otros proyectos
	Estudios Ecológicos	1. Monitoreo biológico georeferenciado 2. Mapas de presencia de las tres especies 3. Predadores y/o parasitoides, enemigos naturales de las polillas de la papa colectados	1.1 Plan de muestreo 1.2 Modelos predictivos de la repartición de las plagas 1.3 Número de visitas a campos de papa, bodegas y mercados en las provincias de Chimborazo, Cotopaxi, Tungurahua y Bolívar	

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			Biodiversidad	**Bienestar**
	Transferencia de tecnología	1. Línea base y plan de trabajo 2. Material didáctico elaborado 3. Capacitadores capacitados		1.1 Estudio sobre plagas en campo, daño e incidencia de la polilla, nivel de conocimiento sobre la plaga 2.1 Unidades de capacitación sobre manejo integrado de las polillas de la papa 2.2 Plan de capacitación diferenciado por edad 2.3 Numero de grupos diferenciados por edad capacitados en la comunidad Guntuz 3.1 Numero de productores de la comunidad El Toldo capacitados
	Coordinación interinstitucional	1 Formación del Comité Directivo/ Equipo de Trabajo Operativo/ Evaluaciones anuales		1.1 Reuniones de trabajo
IFAD NUS Bolivia Fase I	Suministro de material genético de las especies objetivo	1. Organización de ferias de semillas 2. Regeneración de las accesiones	1.1 Numero de ferias de biodiversidad organizadas 1.2 Numero de variedades regeneradas y multiplicadas	
	Conservación de germoplasma y de los conocimientos tradicionales asociados	1. Colección básica 2. Capacitación sobre toma de muestras de germoplasma 3. Conservación *ex situ* 4. Caracterización 5. Selección participativa de variedades 6. Inventario de la diversidad 7. Desarrollo de listas de descriptores 8. Distribución de semilla mejorada	1.1 Numero de variedades de la colección básica 2.1 Cursos universitarios orientados a la recolección de granos andinos 3.1 Instalaciones del banco de germoplasma nacional mejoradas 4.1 Variedades y variabilidad genética caracterizadas 5.1 Estudio sobre quinua, cañahua y amaranto 5.2 Tipos de granos andinos seleccionados y evaluados con los agricultores 6.1 Estudio de microcentros de diversidad genética para cañahua 7.1 Lista de descriptores	

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			Biodiversidad	**Bienestar**
			8.1 Cuantidad de semilla distribuida	
	Documentación de los conocimientos sobre usos, limitaciones y oportunidades	1. Encuestas socioeconómicas 2. Manuales para los productores 3. Catálogo de la colección de germoplasma de quinua	1.1 Numero de encuestas sobre usos locales, tendencias de cultivo y otras cuestiones llevadas a cabo en los hogares y los mercados de los cultivos 1.2 Estudios sobre las limitaciones y oportunidades en el uso de la quinua, el amaranto, y la cañahua 2.1 Numero de manuales de instrucciones y técnicas para los productores 3.1 Catalogo	
	Acciones impulsadas por la comunidad para mejorar la generación de ingresos	1. Mejores técnicas de cultivo 2. Estudios nutricionales	2.1 Análisis de los valores nutricionales de la harina de quinua 2.2 Evaluación del impacto nutricional del amaranto	1.1 Trilladora de quinua, cañahua y amaranto 1.2 Pruebas de cosecha mejorada y tecnologías post-cosecha 1.3 Número de visitas a las plantas de procesamiento 1.4 Numero de pruebas de procesamiento 1.5 Tesis de investigación sobre análisis de costes y beneficios de la comercialización de la quinua y cañahua 2.3 Tecnologías mejoradas para el consumo de amaranto en el ámbito familiar 2.4 Talleres para promover el uso de amaranto por sus valores nutricionales 2.5 Pruebas culinarias de quinua y cañahua

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			Biodiversidad	**Bienestar**
	Acciones dirigidas al mercado, comercialización y limitaciones de la demanda	1. Conectar los agricultores con los actores de las 'filieres' 2. Capacitación / talleres locales para los miembros de la Comunidad 3. Análisis de costos y beneficios 4. Proyectos piloto para apoyar a los agricultores en la toma de decisiones sobre la cultivación de cañahua y quinua	1.1 Evaluación participativa de la quinua y la cañahua 1.2 Numero de productos de amaranto promocionados	1.3 Reunión entre los agricultores y representantes del sector privado 1.4 Visitas de los agricultores líderes a agroindustrias 1.5 Encuesta para investigar las dificultades encontradas a lo largo de las cadenas de producción y distribución de los granos andinos 2.1 Numero de actividades con empresas locales 2.2 Taller entre todos los actores de las 'filieres' de quinua y cañahua 2.3 Cursos y talleres sobre la producción, transformación y comercialización 2.4 Cursos en procesamiento y cocina 2.5 Taller en metodologías participativas dirigidas a estudiantes, técnicos y profesionales 2.6 Estudio con la Universidad Católica Boliviana sobre las mujeres y la nutrición 2.7 MSc sobre chocho en colaboración con la Universidad de Cornell, USA 2.8 Taller sobre la agroindustria de granos andinos y los requisitos técnicos para la transformación 3.1 Análisis de costos y beneficios 4.1 Número de proyectos pilotos 4.2 Talleres de cooperación interinstitucional
	Marcos normativos y jurídicos y sensibilización del público	1. Aspectos legales y de políticas agrarias 2. Sensibilización del público		1.1 Norma nacional para el cultivo de granos andinos elaborada 1.2 Taller en La Paz para discutir la situación de las políticas 2.1 Spot publicitarios, entrevistas en TV y radio 2.2 Folletos en idioma español y local 2.3 Feria demostrativa con diferentes platos con amaranto 2.4 Boletín sobre las propiedades nutricionales de los cultivos andinos subutilizados 2.5 Boletín de recetas hechas con quinua 2.6 Taller para promover el uso de diversos platos de amaranto 2.7 Campaña promocional sobre el uso del amaranto

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				2.8 Artículos sobre los valores nutricionales de los granos andinos
IFAD NUS Bolivia Fase II	Evaluación y mejora de la generación de ingresos basados en los NUS	1. Datos sólidos sobre la economía de los NUS y los beneficios y costos asociados con su cultivo y comercialización recogidos 2. Competitividad de NUS /productos en sitios piloto lograda junto con una imagen mejorada, una mayor demanda y mercados más eficientes 3. Mejores conocimiento de las necesidades agronómicas y prácticas sostenibles de producción agrícola	1.1 Documento sobre oferta y demanda de amaranto 1.2 Análisis de los costes de producción de amaranto 2.1 Estrategia de manejo integrado de plagas 3.1 Diagnostico de plagas y fertilización 3.2 Validación y difusión de la fertilización de amaranto	
	Evaluación de los valores nutricionales de NUS y desarrollo de estrategias para una mejor utilización de NUS en programas de nutrición	1. Los valores nutricionales de los NUS objetivo evaluados en particular en las zonas afectadas por la desnutrición y el hambre oculta 2. Impacto actual y potencial de las especies objetivo evaluado en todos los grupos y zonas prioritarias 3. Estrategias para mejorar la utilización de NUS altamente nutritivos elaboradas y difundidas	1.1 Datos sobre la población, la salud y la nutrición en las comunidades de destino 1.2 Análisis complementario del valor nutricional del amaranto 1.3 Encuestas alimentarias 2.1 Estudio de la calidad de las proteínas en la dieta según la edad y el sexo 2.2 Investigación sobre la calidad nutricional del amaranto de acuerdo a la edad 2.3 Estudios antropométricos	2.4 Estudio de impacto de amaranto en los niños 3.1 Nuevos productos derivados NUS 3.2 Prototipo de tecnología de "expansión continua" para el procesamiento de amaranto 3.3 Agentes educados en nutrición 3.4 Número de miembros de la comunidad capacitados en nuevos productos 3.5 Máquina para la producción continua de popcorn

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	Mejora del capital humano y social de los interesados para gestionar los NUS y los beneficios derivados de su uso, combinado con el fortalecimiento de la identidad local	1. Mejora de las capacidades de los miembros de la comunidad a través de cursos / talleres y otras iniciativas de creación de capacidad 2. Estrategia de valor agregado basada en la comunidad además de establecida/fortalecida en los sitios piloto 3. Planes de estudio sobre los NUS desarrollados y promovidos para la construcción de capacidades humanas en el ámbito de los NUS 4. SHG, CIALs y otras organizaciones comunitarias establecidas en los sitios piloto 5. Métodos y enfoques para empoderar a las mujeres a través de NUS en los sitios objetivo, en particular mediante su gestión directa de la cultura alimentaria local y las iniciativas relacionadas 6. Aumento de la auto-estima de las personas a través de iniciativas comunitarias / regionales / nacionales que reconocen la contribución de la población local como "custodios NUS" y "campeones NUS" 7. Mayor conciencia del papel de los NUS en los medios de subsistencia de los pueblos a través de material educativo y otros mensajes culturalmente orientados para generaciones más jóvenes		1.1 Número de agricultores y técnicos formados 1.2 Estudio de utilidad de las máquinas de proceso 1.3 Machinas trilladoras / eliminadoras de saponina para la quinua 1.4 Número de agricultores capacitados en el ámbito de la alimentación de granos andinos 1.5 Cursos para los agentes de extensión 2.1 Tecnología de desaponificación de quinua 2.2 Recetas de cocina práctica y atractiva defundidas a través de talleres 3.1 Módulos prácticos para la producción de productos transformados a base de granos andinos 3.2 Estudio sobre el diagnóstico del cultivo y la comercialización de amaranto 4.1 Asociación local de productores y otros actores de la cadena de valor de cañihua 4.2 Asociación de agricultores 5.1 Estudio del proceso de toma de decisiones en finca 6.1 Concursos de agrobiodiversidad de Cultivos Andinos 7.1 Número de jóvenes capacitados
	Analizar el papel del turismo rural en la promoción de NUS	1. Una mejor comprensión del turismo rural en el mantenimiento de la diversidad en los países/sitios objetivo. Metodologías y enfoques para la gestión del turismo desarrollados y difundidos por las comunidades locales con un enfoque en la conservación de la identidad cultural y la diversidad genética y la mejora de los medios de vida a través de NUS 2. Productos tangibles incluyen metodologías para minimizar riesgos y maximizar los beneficios asociados, manuales para los		1.1 Academia de turismo en Santiago de Okola 1.2 Numero de itinerarios turísticos 1.3 Taller dedicado a la gastronomía local 1.4 Museo local de la agrobiodiversidad 2.1 Numero de guías locales formadas 2.2 Visitas a Ecuador para compartir experiencias con el trabajo de UCODEP en el ecoturismo 2.3 Iniciativas conjuntas con las tiendas de la compañía Alexander 3.1 Página web 3.2 Publicación científica para difundir las conclusiones de los trabajos sobre turismo rural

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		miembros de la comunidad, publicaciones específicas, salidas, etc. Productos no tangibles incluyen el empoderamiento de los miembros de la comunidad a través del intercambio de experiencias, capacitación y otras intervenciones, una mayor autoestima de los asociados, una mayor cooperación entre los países e instituciones involucradas 3. Folletos y publicaciones diversas que subrayan los múltiples valores de los NUS y sus estrechas conexiones con las culturas locales y la identidad de la gente		en Santiago de Okola
	Mejora de la disponibilidad, el conocimiento y el mantenimiento de la base de recursos genéticos	1. Mayor disponibilidad de germoplasma y conocimientos indígenas de las especies objetivo para medidas provisorias 2. Mayor conocimiento de las características de alta calidad en las especies objetivo y selección de las mejores variedades 3. Sistemas de producción de semilla fortalecidos/establecidos para las especies objetivo garantizando la calidad, una oferta regular y el mantenimiento de la diversidad genética y cultural de los NUS en los sistemas de producción y de mercado 4. Base de recursos de determinadas especies y conocimientos indígenas relacionados mantenidos a través de métodos *in situ* y *ex situ*	1.1 Documento sobre los conocimientos tradicionales en Santiago de Okola y Coromata Media 1.2 Inventario de la agrobiodiversidad en Las Comunidades de Coromata Media y Rosapata 1.3 Microcentros de diversidad reconocidos 2.1 Características de calidad identificadas 2.2 Accesiones de amaranto evaluadas 3.1 Cuantidad de semilla de quinua, cañahua y amaranto producida 3.2 Cuantidad de semilla de calidad de germoplasma de amaranto 3.3 Museo de la Agrobiodiversidad	2.3 Talleres para los agricultores en los criterios y parámetros de calidad 3.4 Normas de certificación para la producción de semillas de amaranto 4.1 Estudio del proceso de toma de decisiones y el papel del género y la edad 4.2

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	Promoción de mejores políticas y marcos legales para la utilización sostenible y equitativa de los NUS	1. Marco normativo y jurídico identificado y soluciones para su mejora propuestas a los socios 2. Conciencia pública elevada entre los responsables políticos sobre las cuestiones y opciones para la mejora de las políticas y marcos legales		1.1 Análisis de Datos Económicos de la Cadena Productiva 1.2 Reuniones Binacionales de expertos 2.1 Talleres 2.2 Políticas promovidas en el Ministerio de la agricultura 2.3 Visitas para discutir la posibilidad de lanzar una plataforma para la promoción de los granos andinos
	Promoción de la cooperación en la gestión de los NUS y sensibilización sobre la importancia de NUS para los medios de subsistencia	1. Mayor conciencia de la importancia económica, social, nutricional y cultural de los NUS entre los diversos interesados a través de la televisión, la radio, talleres, jardines de demostración, hojas informativas, etc. 2. Difusión de los resultados de los proyectos más allá de los socios principales y mejorar las cadenas de valor 3. La oferta y la cadena de valor de las especies objetivo mejoradas a través de vínculos más eficaces entre los actores 4. Fortalecimiento de redes de participación de los actores en distintos niveles		1.1 Monografía sobre la cañahua 1.2 Campañas de sensibilización 1.3 Talleres de diseminación de Tecnologías y Metodologías 1.4 Taller de Difusión en la gestión de productos 1.5 Jingles radio 1.6 Concursos de alimentación 2.1 Libro 2.2 CD-ROM con las tesis de investigación 3.1 Campañas de concienciación 3.2 Participación en eventos 4.1 Socios identificados para concursos gastronómicos
	Movilización de apoyo y recabar fondos para las actividades sobre los NUS	1. Apoyo político para promover un mayor uso de los NUS a nivel local y municipal, así como a nivel regional y nacional obtenida a través de reuniones, talleres y otras iniciativas 2. Notas conceptuales, propuestas de proyectos en apoyo de los NUS desarrollados y aprobados por los donantes	1.1 Seguimiento y evaluación de impacto 1.2 Fundos complementarios	

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IFAD NUS Peru – Fase I	Suministro de material genético de las especies objetivo	1. Selección participativa de las variedades 2. Regeneración y multiplicación	1.1 Ecotipos de cañahua y quínoa evaluados 1.2 Pruebas comparativas de amaranto 2.1 Líneas de cañahua y quínoa regeneradas y multiplicadas	
	Conservación de germoplasma y de los conocimientos tradicionales asociados	1. Recolección 2. Identificación de duplicados 3. Evaluación de la diversidad genética *in situ* 4. Ferias de intercambio de semillas 5. Conservación *ex situ* 6. Conservación *in situ* 7. Evaluación de la erosión genética	1.1 Descriptores de cañahua y quínoa caracterizados 1.2 Colección de amaranto y cañahua 1.3 Estudio de las características deseables 2.1 Accesiones duplicadas identificadas 3.1 Datos sobre la distribución y usos de la diversidad de amaranto 4.1 Competencias de diversidad 4.2 Festivales 5.1 Bancos de germoplasma INIA-Puno e UNA-Puno mejorados 6.1 Iniciativas conjuntas entre los productores 6.2 Encuestas en fincas 6.3 Talleres con los agricultores de amaranto para elaborar una estrategia coordinada 6.4 Acuerdos con los agricultores para llevar a cabo cursos de formación y participar en ferias 6.5 Encuesta en zonas ricas en diversidad en la región de Puno	

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	Documentación de los conocimientos sobre usos, limitaciones y oportunidades	1 Encuesta sobre el uso y el fortalecimiento de las conneciones a lo largo de la cadena de suministro	1.1 Encuesta sobre la cañahua 1.2 Parcelas de demostración de cañahua y días de campo 1.3 Estudio conjunto con la Asociación Agro-Industrial de Cereales Andina sobre los beneficios de cultivo y los costos de producción	
	Acciones impulsadas por la comunidad para mejorar la generación de ingresos	1. Mejoramiento en la transformación local de los granos andinos	1.1 Análisis de los valores nutricionales de cañahua en la producción de donuts y otros snacks 1.2 Estudio sobre el uso de harina de quinua como sustituto del trigo 1.3 Diagnóstico del sector de comercialización de granos andinos en Puno y Juliaca 1.4 Estudio de mercado	1.5 Tecnología de procesamiento 1.6 Iniciativa conjunta con el Municipio de La Unión en el uso de granos de amaranto para la ayuda alimentaria 1.7 Programa piloto con el Municipio de El Collao 1.8 Tesis con la Universidad UNA-Puno sobre la mejora de la transformación industrial de la quinua
	Acciones dirigidas al mercado, comercialización y limitaciones de la demanda	1 Encuesta sobre las 'filières' de quinua amaranto y cañahua 2 Capacitación / talleres locales para los miembros de la Comunidad 3 Exposiciones / competiciones 4 Análisis de costo- beneficio de la comercialización de cañahua y sus productos		1.1 Análisis de las empresas locales dedicadas a la transformación de la quinua, el amaranto y la cañahua 2.1 Curso de capacitación sobre la producción y comercialización de granos andinos 2.2 Métodos para la evaluación y la cosecha de la quinua 2.3 Cursos sobre técnicas de producción, transformación y comercialización de la quinua 2.4 Visitas a plantas de transformación 2.5 Curso en La Unión con empresas de procesamiento de harina de amaranto 2.6 Identificación de las necesidades y oportunidades para fortalecer el sector de transformación en Puno

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				2.7 Reunión en el Cuzco con los productores 2.8 Cursos para la transformación y agregar valor a los productos de quinua y cañahua 2.9 Taller de capacitación para 5 empresas 2.10 Curso sobre la legislación sanitaria de producción y procesamiento de granos andinos 2.11 Talleres demostrativos sobre la transformación de granos andinos 2.12 Curso para la identificación de las enfermedades de los granos andinos 2.13 Proyectos piloto con los municipios locales para mejorar el cultivo y el uso de amaranto con la participación de micro-empresas 2.14 Acuerdo con las Comunidades de Lampa, Yunguyo, Chucuito para un programa piloto para la mejora de uso de los cultivos 3.1 Concurso de platos 3.2 Exposición sobre la diversidad y los usos de los granos andinos 3.3 Libros de recetas 4.1 Análisis de costo-beneficio
	Marcos normativos y jurídicos y sensibilización del público	1 Aspectos legales y de política agraria 2 Sensibilización del público		1.1 Taller en Puno en los aspectos jurídicos y políticos relacionados con el cultivo y la comercialización de granos andinos 1.2 Propuesta de reducción de impuestos con el fin de promover el cultivo de los cultivos andinos e incluirlos en programas de desarrollo social 1.3 Documento sobre todos los aspectos de la producción y comercialización de granos andinos y las políticas agrícolas 2.1 Curso sobre los valores nutricionales de quinua y cañahua 2.2 Folletos diversos sobre los valores nutricionales de los granos andinos 2.3 Propuesta de proyecto sobre la producción y comercialización de la quinua 2.4 Parcelas y talleres demostrativos sobre la diversidad de cañahua 2.5 Spot publicitarios sobre los valores nutricionales

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				de la quinua y cañahua 2.6 Feria "Festiquinua 2003" y Feria de Huancaro
IFAD NUS Peru – Fase II	Evaluación y mejora de la generación de ingresos basados en los NUS	1. Datos sólidos sobre la economía de los NUS y los beneficios y costos asociados con su cultivo y comercialización recogidos 2. Competitividad de NUS /productos en sitios piloto lograda junto con una imagen mejorada, una mayor demanda y mercados más eficientes 3. Mejores conocimiento de las necesidades agronómicas y prácticas sostenibles de producción agrícola	1.1 Estudio sobre los beneficios 3.1 Líneas promisorias de amaranto planteadas 3.2 Cuantidad de variedad de quinua "Negra Collana" distribuida 3.3 Soluciones tecnológicas innovadoras para las operaciones de trilla 3.4 Ensayos de fertilización orgánica de la quinua 3.5 Genotipos de quinua evaluados	2.1 Talleres para difundir mejores prácticas de cultivo 2.2 Campañas de promoción entre los agricultores y las asociaciones y cursos de extensión sobre las mejores prácticas
	Evaluación de los valores nutricionales de NUS y desarrollo de estrategias para una mejor utilización de NUS en programas de nutrición	1. Los valores nutricionales de los NUS objetivo evaluados en particular en las zonas afectadas por la desnutrición y el hambre oculta 2. Impacto actual y potencial de las especies objetivo evaluado en todos los grupos y zonas prioritarias 3. Estrategias para mejorar la utilización de NUS altamente nutritivos elaboradas y difundidas	1.1 Genotipos de quinua evaluados en ensayos de campo 1.2 Datos secundarios sobre la población, la salud y la nutrición en las comunidades objetivo 1.3 Exposiciones y talleres sobre el uso de la biodiversidad local y la seguridad nutricional 2.1 Evaluación del aporte nutricional a los niños 3.1 Nueva tecnología para promover el uso de la quinua	

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	Mejora del capital humano y social de los interesados para gestionar los NUS y los beneficios derivados de su uso, combinado con el fortalecimiento de la identidad local	1. Mejora de las capacidades de los miembros de la comunidad a través de cursos / talleres y otras iniciativas de creación de capacidad 2. Estrategia de valor agregado basada en la comunidad además de establecida/fortalecida en los sitios piloto 3. Planes de estudio sobre los NUS desarrollados y promovidos para la construcción de capacidades humanas en el ámbito de los NUS 4. SHG, CIALs y otras organizaciones comunitarias establecidas en los sitios piloto 5. Métodos y enfoques para empoderar a las mujeres a través de NUS en los sitios objetivo, en particular mediante su gestión directa de la cultura alimentaria local y las iniciativas relacionadas 6. Aumento de la auto-estima de las personas a través de iniciativas comunitarias / regionales / nacionales que reconocen la contribución de la población local como "custodios NUS" y "campeones NUS" 7. Mayor conciencia del papel de los NUS en los medios de subsistencia de los pueblos a través de material educativo y otros mensajes culturalmente orientados para generaciones más jóvenes		1.1 Encuesta sobre las necesidades de formación de los productores de amaranto 1.2 Cursos de transferencia de tecnología 1.3 Curso de formación para actores de la cadena de valor 2.1 Días de Campo para la quinua y cañihua 3.1 Formación de los agricultores para identificar y evaluar el grado de incidencia de la enfermedad en el campo 4.1 Talleres participativos dirigidos a las organizaciones de productores sobre preparación de la tierra, siembra y semillas de calidad de los granos andinos 5.1 Estudio para evaluar el papel del género en el cultivo y la creación de valor agreagdo de los granos andinos 5.2 Cursos para empoderar a las mujeres agricultoras mediante la transferencia de tecnología 6.1 Stand en el Festival de la Diversidad Biológica en Lima 6.2 Acuerdo con la Comunidad de Cabana para el establecimiento de parcelas demostrativas de quinua para promover las mejores variedades 7.1 Cursos para la difusión de métodos y herramientas para fortalecer los puntos débiles identificados a lo largo de la cadena de valor de amaranto 7.2 Formación durante el Festival de amaranto 7.3 Competiciones de alimentos

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	Analizar el papel del turismo rural en la promoción de NUS	1. Una mejor comprensión del turismo rural en el mantenimiento de la diversidad en los países/sitios objetivo. Metodologías y enfoques para la gestión del turismo desarrollados y difundidos por las comunidades locales con un enfoque en la conservación de la identidad cultural y la diversidad genética y la mejora de los medios de vida a través de NUS 2. Productos tangibles incluyen metodologías para minimizar riesgos y maximizar los beneficios asociados, manuales para los miembros de la comunidad, publicaciones específicas, salidas, etc. Productos no tangibles incluyen el empoderamiento de los miembros de la comunidad a través del intercambio de experiencias, capacitación y otras intervenciones, una mayor autoestima de los asociados, una mayor cooperación entre los países e instituciones involucradas 3. Folletos y publicaciones diversas que subrayan los múltiples valores de los NUS y sus estrechas conexiones con las culturas locales y la identidad de la gente		1.1 Visitas para evaluar los posibles sitios para el trabajo de agroturismo 2.1 Actividad para promover granos andinos a través del turismo 2.2 Acuerdo de Colaboración con la Municipalidad de Mollepata sobre la inclusión de algunos lugares de interés de amaranto (diversidad genética y cultural) a lo largo del camino con el objetivo de popularizar el uso del amaranto y su aporte nutricional 2.3 Desarrollo de una pequeña guía con la diversidad de amaranto y sus múltiples usos en el distrito de Mollepata
	Mejora de la disponibilidad, el conocimiento y el mantenimiento de la base de recursos genéticos	1. Mayor disponibilidad de germoplasma y conocimientos indígenas de las especies objetivo para medidas provisorias 2. Mayor conocimiento de las características de alta calidad en las especies objetivo y selección de las mejores variedades 3. Sistemas de producción de semilla fortalecidos/establecidos para las especies objetivo garantizando la calidad, una oferta regular y el mantenimiento de la diversidad genética y cultural de los NUS en los sistemas de producción y de mercado 4. Base de recursos de determinadas especies y conocimientos indígenas relacionados mantenidos a través de métodos *in situ* y *ex*	1.1 Actividades de conservación en finca y actividades de evaluación genotipo quinua y cañahua 2.1 Caracterización agro-morfológica de germoplasma representativo de amaranto 2.2 Líneas de quinua potencialmente interesantes evaluadas en ensayos con los agricultores 3.1 Sistema de producción de amaranto: germoplasma de amaranto refrescado en el banco de genes de Cusco, accesiones evaluadas junto con los agricultores y material promisorio seleccionado	

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		situ	3.2 Parcelas demostrativas de semillas y parcelas de semillas de alta calidad plantadas para la multiplicación de las variedades seleccionadas 4.1 Producción de semillas en estrecha colaboración con los productores en el distrito de Cabana 4.2 Actividades para fortalecer la producción de semillas con el fin de satisfacer la demanda de cañahua 4.3 Estudios de la colección central de germoplasma de amaranto con el fin de facilitar la evaluación y selección de actividades 4.4 Colección básica de semillas de alta calidad creada por la asociación local de agricultores	
	Promoción de mejores políticas y marcos legales para la utilización sostenible y equitativa de los NUS	1. Marco normativo y jurídico identificado y soluciones para su mejora propuestas a los socios 2. Conciencia pública elevada entre los responsables políticos sobre las cuestiones y opciones para la mejora de las políticas y marcos legales	1.1 Desarrollo de un marco para investigar el impacto de prácticas no sostenibles relacionadas con el cultivo de granos andinos 1.2 Análisis nacional de las estadísticas relacionadas con el cultivo, procesamiento, comercialización y uso de los cultivos de papa nativa peruana, quinua, cañahua, chocho, oca, olluco, isano, frijol lima, que cubre el período 1998-2006 2.1 Desarrollo de un libro sobre los resultados de la fase I en Perú 2.2 Posibilidad de establecer un mecanismo nacional auto sostenible que guía todos los esfuerzos futuros en la conservación y el uso de granos andinos investigada	

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	Promoción de la cooperación en la gestión de los NUS y sensibilización sobre la importancia de NUS para los medios de subsistencia	1. Mayor conciencia de la importancia económica, social, nutricional y cultural de los NUS entre los diversos interesados a través de la televisión, la radio, talleres, jardines de demostración, hojas informativas, etc. 2. Difusión de los resultados de los proyectos más allá de los socios principales y mejorar las cadenas de valor 3. La oferta y la cadena de valor de las especies objetivo mejoradas a través de vínculos más eficaces entre los actores 4. Fortalecimiento de redes de participación de los actores en distintos niveles		1.1 Apoyo a la organización del 10 º Festival de la Quinua, Cañahua 1.2 Talleres comunitarios de difusión de la tecnología de quinua y cañahua 2.1 Participación en el "Festiquinoa" Festival 2.2 Festivales de quínoa y cañahua 2.3 Libro regulador de las técnicas de cultivo 3.1 Primer borrador de una norma técnica sobre la comercialización de la quinua en el Perú desarrollado en colaboración con diversas asociaciones 3.2 Organización de la sinergia entre 30 organizaciones diferentes que están activamente involucrados en la cadena de valor de la quinua 4.1 Establecimiento de una plataforma multilateral y un marco estratégico para la conservación y utilización sostenible de granos andinos en el Perú 4.2 Participación en la Reunión del Consejo Regional para la Seguridad Alimentaria (Consejo Regional de Seguridad Alimentaria, CORSA) del Cuzco
	Movilización de apoyo y recabar fondos para las actividades sobre los NUS	1. Apoyo político para promover un mayor uso de los NUS a nivel local y municipal, así como a nivel regional y nacional obtenida a través de reuniones, talleres y otras iniciativas 2. Notas conceptuales, propuestas de proyectos en apoyo de los NUS desarrollados y aprobados por los donantes	1.1 Acuerdo sobre la empresa de una serie de tareas conjuntas con el Proyecto ALTAGRO 1.2 Reuniones con la oficina de COSUDE en Lima para recaudar fondos para la organización de un Taller de Partes Interesadas 2.1 Apoyo del Proyecto FIDA Corredor Puno-Cusco para ensayos de producción orgánica en el sitio de Corisuyo	

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Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA	Asegurar la conservación del germoplasma de Granos Altoandinos del país e incrementar sus posibilidades de uso a través de un trabajo coordinado entre el Banco Activo de Germoplasma del Subsistema, las Colecciones de Trabajo y otras alianzas estratégicas.	Conservación *ex situ* 1. Colecciones de germoplasma incrementadas 2. Consolidación de dos formas de almacenamiento 3. Caracterización y evaluación de colecciones de germoplasma 4. Regeneración y multiplicación 5. Documentación	1.1 Numero de colecciones de germoplasma incrementadas 2.1 Formas de almacenamiento mejoradas 3.1 Colecciones caracterizadas agro-morfológicamente 3.2 Colecciones caracterizadas molecularmente 3.3 Colecciones caracterizadas en términos del valor nutritivo y agroindustrial 4.1 Cuantidad de semillas regenerada y multiplicada 5.1 Centro de Documentación (CENDOC) especializado en Granos Andinos 5.2 Implementación de la base de datos SIRGEN	
		Experiencias *ex situ- in situ*: 1. Ferias de biodiversidad 2. Visitas al Banco Nacional de Germoplasma de Granos Altoandinos (BNGA) 3. Evaluaciones participativas 4. Bancos comunales 5. Seguimiento a parcelas familiares	1.1 Numero de ferias de biodiversidad institucionalizadas y realizadas 2.1 Visitas de actores de la cadena productiva de granos andinos y otros actores del Subsistema 3.1 Evaluaciones participativas con germoplasma de quinua 4.1 Número de bancos comunales de quinua implementados 5.1 Selección y distribución de semillas de variedades y accesiones de quinua y cañahua a agricultores	
		Fortalecimiento de la conservación *in situ*: 1. Identificación de microcentros de diversidad 2. Inventarios de agrobiodiversidad 3. Caracterización de la agrobiodiversidad 4. Caracterización de conocimientos tradicionales	1.1 Sitios piloto para la conservación *in situ* identificados 2.1 Identificación de la agrobiodiversidad conservada en las comunidades 3.1 Variedades de los cultivos andinos caracterizadas	4.1 Conocimiento tradicional asociado a la conservación de la agrobiodiversidad caracterizado 5.1 Numero de concursos 6.1 Microcentros de diversidad reconocidos 7.1 Número de encuentros con los agricultores

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		5. Concursos de agrobiodiversidad 6. Reconocimiento a microcentros de diversidad 7. Intercambio de experiencias y conocimientos tradicionales		
		Fortalecimiento del uso: 1. Mejoramiento genético 2. Distribución de semillas 3. Accesiones de cañahua con potencial forrajero 4. Cursos de usos diversificados 5. Registro de variedades de cañahua 6. Vinculo con el mercado	1.1 Cuantidad de material genético mejorado 2.1 Numero de accesiones de variedades distribuidas a las comunidades y a las instituciones 3.1 Numero de accesiones seleccionadas	4.1 Recetas tradicionales documentadas 4.2 Hornos artesanales de barro construidos 5.1 Numero de variedades registradas 5.2 Vínculos entre agricultores que producen y conservan quinua 6.1 Organizaciones fortalecidas
		1. Promoción y difusión de información		1.1 Conferencias 1.2 Ferias 1.3 Periódicos 1.4 Programas radiales y televisivos 1.5 Publicaciones
		1. Capacitación a actores del Subsistema		1.1 Capacitación impartida por el personal del Subsistema 1.2 Capacitación recibida por el personal del Subsistema 1.3 Capacitación a agricultores
		1. Colecciones de Trabajo		1.1 Colección de Trabajo de la UTO 1.2 Colección de Trabajo de la UMSA 1.3 Colección de Trabajo del CIPROCOM

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Desarrollo Sostenible de Quinua Orgánica en el Perú	Mejorar la producción y los sistemas de mercadeo de la quinua con la finalidad de contribuir a la seguridad del suministro de alimentos, generación de ingresos y preservación del medioambiente en la zona andina	1. Generación de una tecnología validada para la producción orgánica de quinua con énfasis en el manejo orgánico del qhona qhona 2. Desarrollo de una tecnología alternativa con fertilizantes orgánicos y manejo agronómico 3. Promoción, organización y capacitación de las partes que interactúan en la cadena de la producción de la quinua orgánica 4. Estudio de los mercados reales y potenciales para la quinua orgánica y convencional 5. Formulación de un plan empresarial para la producción y para las empresas de servicio que entran a formar parte del mercado orgánico 6. Difusión y adopción de la nueva tecnología	1.1 Numero de variedades resistentes identificadas 1.2 Pruebas de la eficiencia de control 1.3 Manual técnico para los agricultores 2.1 Estudios sobre la aplicación de fertilizantes orgánicos 2.2 Estudios de los sistemas de producción y tecnologías 2.3 Publicación técnica para los agricultores	3.1 Organización y capacitación de los agricultores 3.2 Establecimiento de asociaciones 3.3 Presentación del informe de medio año 4.1 Plan de investigación 4.2 Información, nacional e internacional compilada 4.3 Análisis de datos 4.4 Informe sobre el estudio de mercado 5.1 Plan de acción 6.1 Conferencias, TV, radio 6.2 Días de campo 6.3 Entrevistas para analizar la importancia de la quinua como un producto alimenticio entre diferentes grupos de personas e instituciones 6.4 Encuestas a consumidores de quinua, Puno 6.5 Cursos prácticos de capacitación 6.6 Festivales gastronómicos
Sustainable production of quinoa: a neglected food crop in the Andean region	Implementar una estrategia para la conservación *ex situ* e *in situ* de los recursos genéticos de quinua	1. Las colecciones en el Banco Nacional de Germoplasma de Granos Altoandinos (BNGA) se mantienen en condiciones adecuadas 2. Caracterización de la variación genética de los recursos genéticos de quinua a nivel fenotípico y molecular y desarrollo de una colección básica 3. Estregia de conservación *in situ* desarrollada 4. Establecimiento de un programa de conservación a largo plazo y fortalecimiento del programa de conservación a corto plazo para la colección de germoplasma de quinua	1.1 Numero de accesiones de quinoa multiplicadas 2.1 Colección básica de quinua construida 2.2 Numero de accesiones de la colección básica evaluadas en términos nutricionales 3.1 Numero de subcentros de diversidad genética y flujo de semillas en las regiones sur, centro y norte del Altiplano	2.3 Informacion agronómica, nutricional y morfológica de 59 caracteres cuantitativos y cualitativos recogida 3.2 Estudio sobre el papel de la mujer en la adopción de la tecnología y la toma de decisiones en la conservación de quinua en el Altiplano Sur 3.3 Estrategias para la conservación de germoplasma *in situ* a través de los CIALs 4.1 Estudio sobre la determinación de humedad y temperatura para el almacenamiento de semillas

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	Establecer un programa de reproduccion y mejoramiento genético de la quinua, utilizando herramientas modernas de reproducción y biotecnología	1 Mejora del programa de reproduccion de quinua existente con instalaciones adecuadas y mecanización, y el establecimiento de un enfoque moderno de fitomejoramiento 2 Desarrollo de métodos para el manejo integrado de plagas y enfermedades	1.1 Numero de híbridos de genotipos desarrollados 1.2 Estudio de los aspectos genéticos básicos para la reproducción de la quinoa 1.3 Estudio agronómico y morfológico de la resistencia al mildiú en accesiones seleccionadas del banco de germoplasma 1.4 Estrategia de integración desarrollada para obtener nuevas variedades, el mantenimiento de su pureza, y producción de semillas 1.5 Numero de variedades mejoradas difundidas, promocionadas y multiplicadas	1.6 Estudio participativo de evaluación y selección de calidad culinaria y comercial 1.1 Estudio de la línea base para identificar las estrategias de los agricultores para el control de plagas 1.2 Estrategia de manejo integrado de plagas desarrollada
	Desarrollo de componentes para la producción sostenible y comercialización de la quinua	1 Características asociadas con resistencia a la sequía identificadas 2 Tecnologias de cosecha y post cosecha de quinua mejoradas 3 Potencial agroindustrial de la quinua y opciones de mercado evaludas	1.1 Estudios sobre la resistencia de las accesiones de quinoa de la collecion básica y el uso de abonos verdes	2.1 Numero de métodos alternativos de siembra de quinoa desarrollados 2.2 Numero de participante en las actividades de promoción de las técnicas alternativas 3.1 Estudio socioeconómico sobre las comunidades y la demanda de agroindustrias de la quínoa
	Mejoramiento de los programas de extensión con el objetivo de fomentar la capacidad de la población rural para el desarrollo económico y la autosuficiencia nutricional	1 Programas de capacitación y difusión de la información implementados		1.1 Número de estudiantes, técnicos y agricultores capacitados 1.2 Número de agricultores capacitados en las ECAs 1.3 Numero de folletos, artículos y documentos promocionales
Lupin/Quinoa: Sustainable production systems to guarantee food security in impoverished communities in the province of	Fortalecer los sistemas de producción de las comunidades Ninín Cachipata, Chaluapamba, Chilla Chico y Canchagua, mediante el mejoramiento y promoción de la quinua y el chocho	1. Definición de la línea base del proyecto en Ninín Cachipata, Chaluapamba, Chilla Chico y Canchagua y Canchagua 2. Revalorización del saber campesino en el manejo de sistemas de producción 3. Investigación e implementación de nuevas prácticas para fortalecer los sistemas de producción 4. Parcelas demostrativas sobre manejo de	2.1 Ensayos sobre asociación de cultivos, mejoramiento del sistema de siembra tradicional, rotación de cultivos planteados con diferentes alternativas y repeticiones de chocho, quínoa, papa y cebada 2.2 Uso de plaguicidas en los sistemas de producción monitoreado 3.1 Ensayos de líneas promisorias de chocho	1.1 Diagnóstico Rural Participativo y encuestas predefinidas 4.1 Lotes demostrativos de quinua y chocho en comunidades nuevas para el proyecto

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Cotopaxi, Ecuador (Sistemas de producción sostenibles para garantizar la seguridad alimentaria en comunidades pobres de la provincia de Cotopaxi, Ecuador)**		quinua y chocho	y quínoa de grano dulce 3.2 Semilla de las variedades seleccionadas multiplicada 3.3 Numero de nuevas variedades evaluadas	
	Evaluar y seleccionar variedades de quinua y chocho que se adapten a las condiciones edafoclimáticas y de acuerdo a los criterios y preferencias de los agricultores (as) de las comunidades Ninín Cachipata, Chaluapamba, Chilla Chico y Canchagua.	1. Desarrollo de líneas de quinua y chocho en invernadero(Estación Experimental) y campo abierto (Latacunga) 2. Evaluación participativa de líneas promisorias de quinua y chocho	1.1 Numero de variedades genéticamente mejoradas	2.1 Ensayos de diferentes cultivos del sistema de producción evaluados con los CIALs de las cuatro comunidades
	Identificar aplicaciones agroindustriales de variedades y líneas promisorias de quinua y chocho.	1. Análisis bromatológicos 2. Estudios amilográficos para identificar propiedades viscoelásticas en masas de chocho y quinua 3. Desarrollo de productos en base de quinua germinada, fermentada y extruida		1.1 Características químicas de variedades y líneas promisorias de quinua y chocho determinadas 1.2 Estudio sobre el contenido de ácidos grasos en chocho 1.3 Estudio sobre el aporte nutricional de la quinua y el chocho 2.1 Masa base para pizza elaborada a partir de chocho 2.2 Sopa instantánea de quinua dulce elaborada
	Desarrollar un sistema informal para la producción y distribución de semilla de buena calidad de los principales cultivos componentes de los sistemas de producción de las comunidades Ninín Cachipata, Chaluapamba, Chilla Chico y Canchagua.	1. Ensayos sobre producción de semilla (época de siembra, manejos de plagas y enfermedades, cosecha, trilla, secado, almacenamiento) 2. Lotes de producción de semilla 3. Intercambio y distribución de semilla	1.1 Cuantidad de semilla de quinua y chocho purificada y multiplicada 3.1 Lotes y días de campo para la difusión dentro de la parroquia y en otras comunidades de la línea de chocho seleccionada por el CIAL	2.1 Cursos sobre producción y manejo de semilla de granos andinos
	Promocionar y diversificar el consumo de los granos andinos (quinua y chocho).	1. Talleres para identificar formas ancestrales de consumo y preparar nuevas recetas en base de quinua y chocho 2. Estudio del sistema alimentario; promoción, diversificación y monitoreo del consumo de quinua y chocho a nivel familiar y		1.1 Capacitación de voluntarias de las comunidades Ninín Cachipata, Chaluapamba, Chilla Chico y Canchagua (Taller) 1.2 Talleres de preparación de recetas en base de quinua y chocho 1.3 Taller de procesamiento de chocho a nivel

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			Biodiversidad	**Bienestar**
		comunitario en Ninín Cachipata, Chaluapamba, Chilla Chico y Canchagua 3. Conferencias en las escuelas y colegios de la zona para concienciar sobre el valor nutritivo de los granos andinos 4. Spots publicitarios en radio y prensa de la provincia de Cotopaxi		familiar 1.4 Taller de la agrocadena del chocho 2.1 Estudio sobre el efecto del consumo de chocho en la composición de ácidos grasos en la leche materna 2.2 Consumo de quinua y chocho a nivel de hogar monitorado 3.1 Numero de eventos de capacitación y difusión: ferias demostrativas, ferias de intercambio, convenios, conferencias, intercambios de experiencias 3.2 Numero de campañas publicitarias
	Fortalecer la capacidad de investigación agrícola por parte de los agricultores (CIAL's, ECA's) y establecer vínculos con el INIAP y otras instituciones para propender el desarrollo sostenible de comunidades pobres de Cotopaxi.	1. Conformación CIAL's y capacitación en manejo de ensayos, evaluaciones participativas, análisis de datos y presentación de resultados		1.1 Numero de CIALs conformados
	Impulsar la creación de microempresas para dar valor agregado y comercializar la producción de granos andinos.	1. Capacitación y estudio de factibilidad para dos microempresas		1.1 Procesos desarrollados para la producción de nuevos productos en base de quinua y chocho 1.2 Productos en base de quinoa seleccionados y estudiados a nivel comnuitario y rural
	Monitorear y evaluar el avance del proyecto	1. Evaluación participativa del Proyecto 2. Intercambio de experiencias		1.1 Numero de reuniones, talleres, reportes 2.1 Numero de vistias a otras comunidades
Conservación complementaria *ex situ - in situ* de especies silvestres de quinua y cañahua en Bolivia	Mejorar el estado de conservación de los parientes silvestres de cultivos del género Chenopodium a través del fortalecimiento del manejo de información disponible en el Banco Nacional de Granos Altoandinos (BNGA) de las colecciones de germoplasma de especies silvestres de quinua y cañahua para la conservación	1 Clasificación de las accesiones de quinua silvestres y cañahua en El Banco Nacional de Granos Altoandinos (BNGA) 2 Documentación de los conocimientos tradicionales de las especies silvestres de quinua y cañahua en Titijoni, Cachilaya, Coromata Media, Santiago de Okola and Cariquina Grande 3 Evaluación del valor nutricional y agroindustrial de la quinua y cañahua silvestres	1.5 Base de datos del banco ampliada con información ecogeográfica de las colecciones de quinua y cañahua silvestres 1.6 Identificación taxonómica de 44 accesiones de cañahua silvestres y 59 accesiones de quinua silvestre 1.7 Germoplasma de quinua y cañahua silvestres caracterizado 1.8 Numero de nuevas accesiones recolectadas	4.1 Libros para promover la cañahua y quinua silvestre 4.2 Programas de radio 4.3 Seminarios para estudiantes de secundaria en las escuelas rurales 4.4 Ferias provinciales

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	ex situ – in situ.	4 Difusión de información a los agricultores, las comunidades y escuelas rurales para promover las especies silvestres de quinua y cañahua	2.1 Estudio del sistema de clasificación de los agricultores 3.1 Numero de accesiones de quinua y cañahua silvestres analizadas en los aspectos nutricionales	
Programa de apoyo a la cadena quinua altiplano sur	Adaptar, rescatar, validar y promover uso de tecnología adecuada a los contextos de los procesos productivos de la cadena quinua orgánica	1. Desarrollo de una estrategia adecuada de manejo de suelos 2. Mecanización 3. Fomentar el uso de técnicas apropiadas de control de plagas 4. Mejoramiento de prácticas de cosecha y post cosecha 5. Agrobiodiversidad y semillas 6. Difusión de la información 7. Saber local	1.1 Estudios de suelos 1.3 Estudios sobre la incorporación de abonos orgánicos 3.1 Controladores biológicos en plagas de quinua evaluados 3.2 Entomopatógenos en el Altiplano Sur identificados 3.3 Feromonas específicas para plagas de la quinua desarrolladas 3.4 Estudio de la entomofauna benéfica asociada al cultivo de la quinua 4.1 Cuantidad de semilla certificada de quinua real producida 4.2 Numero de accesiones recolectadas para el germoplasma de la UTO	1.2 Numero de planes municipales de Manejo de Suelos 1.4 Estudios de los beneficios de sistemas agroforestales en el Altiplano Sur 2.1 Estudio comparativo de cuatro tipos de arados 3.5 Trampas de luz evaluadas y difundidas 4.1 Numero de trilladoras y venteadoras desarrolladas 6.1 Numero de experiencias sistematizadas 6.2 Base de datos 6.3 Publicacion mediante web 1.1 Estudio sobre las aproximaciones etnobotánicas en áreas productoras de quinua real
Green manure and legumes: integrating agronomic and health research for improving the production of food and diets in marginal areas of Northern Potosi**	Capacitar a actores locales para identificar opciones para expandir el rol de los abonos verdes, forrajes y granos de leguminosas en la rotación de los cultivos que impacten positivamente en la salud del suelo y la capacidad productiva de la familia, en el Norte de Potosí en los Municipios de Sacaca, San Pedro de Buenavista y Acasio.	1. Con ensayos comunitarios, identificar dos o más especies de abonos verdes y forrajes dos o más variedades de granos de leguminosas que se adapten al área y tengan un impacto positivo en la productividad de los cultivos, subsistencia de la familia, salud del suelo y sistema de cultivo sustentable. 2. Las comunidades del área del proyecto conocen y entienden los resultados de la investigación participativa y empiezan a adoptar prácticas para mejorar la producción y la salud del suelo en sus propias tierras 3. Actores rurales de desarrollo (agencias de acción, organizaciones de investigación y gobiernos locales) están informados de los resultados de la investigación para usarlos en futuros trabajos con leguminosas dentro de sistemas de alimentación en las	1.2 Numero de ensayos experimentales participativos 1.3 Numero de parcelas demostrativas y de producción de leguminosas 1.4 Numero de experimentos de abonos verdes para mejorar la salud del suelo 1.5 Numero de ensayos de macetas e invernaderos con especies prometedoras para determinar los aspectos de su impacto en la salud del suelo	1.6 Taller de Planificación 1.7 Trabajos de tesis 1.8 Numero de ferias realizadas 2.1 Número de días de campo comunales e ínter comunales 2.2 Numero de cursillos comunales 2.3 Boletines de divulgación 2.4 Línea de base en seguridad alimentaria 3.1 Folletos de síntesis de los resultados de la investigación

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		comunidades andinas rurales.		
	Construir capacidades locales para innovación agrícola que mejore la salud del suelo y contribuya a un sistema de alimentación más sostenible y productiva.	1. En las áreas del programa, al menos 15 organizaciones comunitarias han emergido o se han fortalecido en sus capacidades para comprometerse a un proceso de desarrollo autodirigido enfocado en la seguridad alimentaria.		4.2 Numero de giras educativas y/o Intercambios comunitarios 4.3 Número de visitas de intercambio 4.4 Numero de talleres de capacitación para la formación de pirámide de liderazgo 4.5 Numero de reuniones comunales 4.6 Cognresos, reuniones institucionales, reunione en sub-alcadias
	Mejorar la nutrición materna infantil con un número de actividades que se construyan sobre ganancias en la productividad de la investigación participativa en leguminosas en las rotaciones de cultivos	1. Mujeres de los grupos participantes de mujeres saben y entienden estrategias para mejorar su estado nutricional y el de sus niños		1.1 Numero de técnicos capacitados en nutrición 1.2 Número de mujeres lideres campesinas capacitadas en la preparación de comida a base de leguminosas y otros componentes 1.3 Recetarios 1.4 Alimentos mejorados para los animales 1.5 Numero de hortalizas introducidas para el consumo 1.6 Estudio de la desnutrición infantil en zonas beneficiarias 1.7 Número de Centros de Madres capacitados en demostraciones culinarias y preparación de algunas dietas utilizando las leguminosas
Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)**	Identificar y caracterizar conocimientos y prácticas relacionadas a los sistemas existentes de agricultura y manejo de suelos en los Andes, y también factores que contribuyan o impidan el desarrollo de agricultura de cobertura apropiada para la conservación y mejoramiento de suelos	1. Sistema para el análisis de diagnóstico y documentación desarrollada en actividad implementada 2. Inventario de sistemas existentes y potenciales 3. Diagnóstico socio-económico de factores que contribuyen o impiden el desarrollo de agricultura de cobertura apropiada para la conservación y mejoramiento de suelos 4. Prioridades estratégicas identificadas por agricultores para dirigir investigación y actividades del proyecto		1.1 Instrumentos para el inventario del sistema 2.1 Lista de sistemas agroecológicos con estrategias de agricultura de cobertura 3.1 Documento sobre la información social, geográfica, técnica, económica y ambiental de los sistemas agroecológicos 3.2 Numero de informes y materiales de difusión 4.1 Numero de reuniones con los agricultores experimentadores para planear los temas de investigación participativa y científica

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	Diseñar y probar sistemáticamente innovaciones tecnológicas que apliquen los principios de agricultura de cobertura, con agricultores de tres zonas ecológicas para identificar las formas más efectivas y sustentables	1. Grupos de agricultores experimentadores establecidos y aliados con científicos y expertos de desarrollo 2. Innovaciones tecnológicas aplican formas de agricultura de cobertura probadas para su efectividad y sustentabilidad		1.1 Numero de talleres de motivación en la parte alta para integración de nuevos agricultores 1.2 Número de encuentros entre agricultores, científicos y expertos 2.1 Número de agricultores, promotores y algunos técnicos que participan a los cursos de formación de facilitadores en Comités de Investigación Agrícola Local (CIAL´s) 2.2 Numero de facilitadores de facilitadores de Escuelas de Campo de Agricultores (ECA) capacitados 2.3 Número de Escuelas de Campo (ECAs) piloto implementadas 2.4 Número de encuentros para intercambiar experiencias entre agricultores de la parte media y alta 2.5 Numero de giras de observación para conocer nuevas experiencias entre agricultores 2.6 Numero de tesis de grado
	Producir documentación efectiva, análisis e intercambio de conocimiento y experiencias entre interesados en desarrollo rural (organizaciones de agricultores, agencias de desarrollo, instituciones de investigación, gobiernos locales y centrales)	N/A	N/A	N/A
In-Situ Conservation of Native Cultivars and Their Wild Relatives - Peru	Conservar *in situ* las especies nativas y sus parientes silvestres (de las especies objetivo) en y alrededor de la chacra.	1. Aumento-mantenimiento de las areas de cultivo seleccionadas en los sitios objetivos de trabajo 2. Variabilidad de los cultivos nativos 3. Conservación de Parientes Silvestres 4. Participación de la población juvenil 5. Reconocimiento del valor de la conservación *in situ*	1.1 Mapas de distribución de las chacras 2.1 Cuantidad de variabilidad nominal de cultivos nativos priorizados mantenida 3.1 Cuantidad de 'diversidad de parientes silvestres' mantenida	4.1 Numero de jovenes que participan en las actividades de conservación in situ de los cultivos nativos priorizados 5.1 Numero de políticas públicas promotoras de la conservación en chacra
	Fortalecer las organizaciones sostenedoras para acrecentar la	6. La organizaciones tradicionales clave responsables de la conservación de la		1.1 Numero de organizaciones claves reconocidas por los agricultores en el ámbito de influencia

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	capacidad de éstas para continuar e intensificar los esfuerzos de conservación en chacra, y para asegurar una participación efectiva de los agricultores y de las comunidades conservacionistas en la distribución de los beneficios	agrobiodiversidad, que aseguran la seguridad alimentaria y la protección ambiental son fortalecidas y revitalizadas, en donde se hayan desgastado o hayan dejado de existir		del proyecto
	La concienciación del valor ecológico, cultural y nutritivo de los cultivos nativos y sus parientes silvestres es elevada a nivel local y nacional y se manifiesta en programas de educación, investigación, políticas públicas y programas de inversión	1. Renovado orgullo por las variedades de cultivos nativos en las comunidades rurales, expresado en la producción, el consumo y la comercialización local continuos de estas variedades 2. Mayor atención reciben los atributos positivos de los cultivos nativos y sus parientes silvestres, y los beneficios de la conservación de la agrobiodiversidad, en las instituciones educativas peruanas.	1.1 Incremento de la producción, consumo y comercialización de variedades de CCNN	1.2 Numero de programas de postgrado y/o facultades que incorporan o fortalecen en su currículo aspectos sobre conservación y uso sostenible de los cultivos nativos y sus parientes silvestres 1.3 Numero de propuestas curriculares participativas sobre producción y conservación de los cultivos nativos para los niveles de primaria, secundaria y educación superior tecnológica
	Establecer un sistema de información y monitoreo que servirá como una importante herramienta de manejo para las actividades de planificación ycoordinación de la agrobiodiversidad en el Perú, y que también permitirá evaluar cuantitativamente la información computarizada del impacto biológico, ecológico, social, cultural, político y económico del proyecto.	1. Un sistema de información y monitoreo funcionando para monitorear la conservación *in situ* de la agrobiodiversidad en áreas principales en el Perú.	1.1 Sistema descentralizado de Información para el monitoreo de la conservación *in situ*	
Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el	Recuperar parte de la biodiversidad forestal a través del manejo sustentable de fincas ganaderas en las comunidades de Nuevo Mundo y Ganaderos Orenses.	1. Incremento de la biodiversidad 2. Comercialización 3. Investigación 4. Capacitación	1.1 Numero de viveros en producción 1.2 Numero de arboretos instalados 1.3 Número de centros de propagación de especies establecidos 1.4 Porcentual de disminución de la tala de bosque	2.1 Centro para comercializar artesanías y plantas ornamentales instalado 3.1 Ingresos por la venta de productos de jardines forestales 3.2 Base de datos con información de 50 especies potenciales para Forestaría Análoga

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			Biodiversidad	**Bienestar**
Noroccidente de Pichincha			1.5 Numero de orquidearios instalados	3.3 Número de especies arbóreas y no arbóreas identificadas 4.5 Número de personas capacitadas en forestaría análoga 4.6 Número de fincas planificadas, implementadas y manejadas con Forestaría Análoga
Conservation of Biodiversity in Pastaza	Conservar y alcanzar la gestión *in situ* de los ecosistemas y la biodiversidad de la selva amazónica en los territorios de las comunidades indígenas de Pastaza	1. Diseño y aplicación de planes de gestión en tres territorios de las comunidades 2. Establecimiento de un Centro de Información Socio-Ambiental de los Territorios Indígenas de Pastaza 3. Diseño e implementación de un programa de Fortalecimiento de Capacidades en Medio Ambiente y Recursos Naturales	1.1 Mapa base de los territorios indígenas de Pastaza 1.2 Mapa de cobertura vegetal 1.3 Mapa base del área de estudio de los territorios de Yana Yacu, Nina y Amarun Lorocachi 1.4 Mapa de uso actual de la tierra en las áreas de estudio 1.5 Modelo Digital del Terreno 1.6 Mapa de los Ecosistemas 1.7 Inventarios de flora y fauna en las 3 comunidades 1.8 Número de especies amenazadas y especies medicinales de la selva amazónica bajo manejo en jardines fitogenéticos ubicados en las comunidades de Yana Yacu, Nina y Amarun Lorocachi	1.10 Numero de Planes de Manejo 1.11 Número de proyectos pilotos 1.12 Talleres para la planificación de los estudios y para el análisis de los resultados 1.13 Talleres para la aprobación de los planes de gestión 1.14 Estudios Socioeconómicos en las 3 comunidades 2.1 Estación de investigación construida y equipada en Yana Yacu 2.2 Base de datos diseñada y estructurada con información socio-ambientales y geográficas 2.3 Sistema de Información Geográfica aplicado a la planificación ambiental, gestión, seguimiento y evaluación de los territorios indígenas de Pastaza 3.1 Programa de capacitación diseñado para técnicos locales y comunitarios especializados en Gestión Ambiental 3.2 Numero de técnicos de las comunidades capacitados en la gestión ambiental y en el proceso de formulación 3.3 Especialistas de la red formados a un nivel superior en temas relacionados con las actividades del proyecto 3.4 Numero de líderes comunitarios capacitados en la gestión ambiental para finalizar el proyecto 3.5 Miembros capacitados de las 3 comunidades seleccionadas que aplican planes de gestión ambiental 3.6 Número de estudiantes de las comunidades de Yana Yacu, Nina y Amarun Lorocachi que asisten a programas universitarios de grado

Project	**Resultados Esperados** *(Los resultados son los efectos probables o logrados a corto y mediano plazo-o los cambios producidos por los productos de una intervención)*	**Productos Generados** *(Las salidas son los productos, bienes de capital y servicios que representan los resultados tangibles, medibles e inmediatos de la intervención)*	**Indicadores de producto** *(Los indicadores de producto miden y verifican la producción de los productos, es decir, los bienes y servicios que son producidos por las entradas. Tienen atributos de cantidad, calidad y de tiempo)*	
			Biodiversidad	**Bienestar**
				3.7 Módulo de escuela diseñado para el aprendizaje de la Sumac Allpa
Conservación complementaria y uso sostenible de cultivos subutilizados en Ecuador. Rescate, promoción y uso de recursos fitogeneticos interandinos del Ecuador	Conservación complementaria de los cultivos en estudio: rescate y conservación de las especies en estudio en condiciones *ex situ*	1. Diagnóstico participativo de los componentes de la finca 2. Documentación de los sistemas formales e informales de abastecimiento de semilla 3. Desarrollo e implementación de estrategias para la conservación en fincas de agricultores 4. Definición y caracterización final de microcentros de variabilidad genética 5. Desarrollo de modelos de fincas para replicación en otras localidades	1.1 Base de datos 2.1 Estudio sobre el flujo de la semilla en forma formal, mercados locales y nacionales e informal 3.1 Banco comunal formado 4.1 Inventario de la agrobiodiversidad	2.2 Talleres de devolución de información, ferias 3.2 Agricultores conservacionistas formados 5.1 Numero de modelos de finca que cuantifican los componentes, interacciones entre ellos, entradas y salidas, desarrollados
	Uso sostenible de la diversidad local	1. Capacitación y formación para el uso de la agrobiodiversidad local y en agroindustrias 2. Capacitación en nutrición 3. Implementación de eventos para impulsar la agro biodiversidad local 4. Capacitación, seguimiento y difusión en métodos alternativos de almacenaje de la producción agrícola 5. Capacitación y seguimiento en manipulación, selección, clasificación y embalaje de los productos priorizados 6. Transformación de productos agrícolas 7. Organización de productores 8. Capacitación en temas de agroindustria y producción casera		1.1 Planta agroindustrial piloto equipada 1.2 Numero de grupos meta en el uso de la agrobiodiversidad con recetas tradicionales, alternativas y de fácil aplicación formados y capacitados 1.3 Capacitación práctica en uso y manejo de registros de producción y comercialización, manejo de equipos e instrumentos de laboratorio al personal encargado de la planta 1.4 Estudios de mercado y factibilidad 2.1 Talleres en consumo, nutrición, posibilidades agroindustriales, opciones gastronómicas 3.1 Numero de ferias de comidas típicas apoyadas 4.1 Número de talleres de manejo post-cosecha 5.1 Número de cursos de embalaje 6.1 Numero de productos desarrollados 6.2 Estudios de factibilidad para los productos 6.3 6.4 Estudio de mercado para productos no transformados 6.5 Estudios de mercado productos frescos 6.6 Plan de Negocios 7.1 Grupos de productores por cultivo formados 8.1 Grupos organizados capacitados en seguridad e

Project	Resultados Esperados *(Los resultados son los efectos probables o logrados a corto y mediano plazo-o los cambios producidos por los productos de una intervención)*	Productos Generados *(Las salidas son los productos, bienes de capital y servicios que representan los resultados tangibles, medibles e inmediatos de la intervención)*	Indicadores de producto *(Los indicadores de producto miden y verifican la producción de los productos, es decir, los bienes y servicios que son producidos por las entradas. Tienen atributos de cantidad, calidad y de tiempo)*	
			Biodiversidad	**Bienestar**
				higiene; buenas prácticas de manufactura; permisos de funcionamiento; etiquetas
	Educacion en agrobiodiversdiad	1. Formación de técnicos y promotores de la UNORCAC 2. Participación en experiencias de conservación de agrobiodiversidad y educación ambiental 3. Validación de módulos en escuelas y en comunidades 4. Desarrollo de la "Guía de Educación en Agrobiodiversidad" 5. Realización de eventos de difusión y participación		6.1 Numero de talleres con promotores, dirigentes indígenas, técnicos y cooperantes de la UNORCAC 7.1 Numero de talleres de evaluación y seguimiento 8.1 Material didáctico y publicación final de manuales de enseñanza 9.1 Eventos de capacitación y de evaluación del proceso de desarrollo de la guía 9.2 Grupo de profesores formados en el tema de la diversidad agrícola 5.1 Unidades de educación ambiental 5.2 Numero de eventos como fiestas, asambleas y encuentros
	Agro-ecoturismo	1. Realización de un diagnostico de línea base del programa de turismo rural 2. Identificación, mejora y promoción de las bellezas etnoculturales, botánicas y pecuarias 3. Promoción a nivel nacional e internacional los paquetes turísticos integrados 4. Establecimiento de alianzas estratégicas a nivel nacional e internacional 5. Capacitación a los guías en temas de agroturismo 6. Capacitación a familias dueñas de albergues y comunidades en agroturismo		1.1 Diagnósticos de línea de base 2.1 Bellezas escénicas y centros de la agrobiodiversidad andina de Cotacachi identificados 2.2 Numero de dueños de alojamientos formados para la reintroducción de cultivos 3.1 Participación en eventos internacionales 4.1 Numero de alianzas turísticas entre actores locales e internacionales 5.1 Número de actores locales capacitados en turismo virtual 5.2 Numero de guías capacitadas 6.1 Número de familias capacitadas 6.2 Número de mujeres capacitadas 6.3 Número de visitas y giras ejecutadas

Project	**Resultados Esperados** *(Los resultados son los efectos probables o logrados a corto y mediano plazo-o los cambios producidos por los productos de una intervención)*	**Productos Generados** *(Las salidas son los productos, bienes de capital y servicios que representan los resultados tangibles, medibles e inmediatos de la intervención)*	**Indicadores de producto** *(Los indicadores de producto miden y verifican la producción de los productos, es decir, los bienes y servicios que son producidos por las entradas. Tienen atributos de cantidad, calidad y de tiempo)*	
			Biodiversidad	**Bienestar**
Conservación y manejo de la agrobiodiversidad en la cordillera de El Cóndor (INIAP)	Contribuir a la conservación y utilización sostenible de los recursos fitogenéticos de los Shuar y Achuar, como una contribución a la seguridad alimentaria, el mantenimiento de los conocimientos etnobotánicos y la preservación de la biodiversidad agrícola en las montañas de El Cóndor	1. Caracterización de los recursos genéticos del área 2. Estudiar el destino de la agrobiodiversidad en el área 3. Caracterización del germoplasma 4. Diseñar e implementar un modelo conceptual en fincas (No se encuentran otras informaciones)	1.1 Microcentro de biodiversidad identificado 1.2 Variedades de frutas, plantas medicinales y raíces y tubérculos amazónica recolectados 2.1 Ferias de conservación de semillas 2.2 Inventario de la agrobiodiversidad en las fincas 3.1 Base de datos de germoplasma 3.2 Número de especies conservadas en el banco de semillas monitoreadas, refrescadas y multiplicadas 3.3 Líneas promisorias identificadas	4.1 Encuesta sobre aspectos agro-forestales y socio-económicos 4.2 Modelos en finca desarrollados con los agricultores 4.3 Centro demostrativo en Gualaquiza
Seed systems. The biological foundation of security in the Andes	Trabajar con comunidades marginales para ganar nuevos entendimientos con respecto a vacíos de conocimiento y barreras estructurales que afectan los sistemas locales de semillas, incluyendo el mejoramiento de especies locales, manejo de recursos genéticos y los sistemas informales de intercambio de semillas	1 Análisis rural participativo de los conocimiento, actitudes y prácticas relacionados a sistemas de semilla existentes y potenciales 2 Investigaciones socioeconómica en los sistemas de semillas y el mercado informal de semillas		1.1 Pre-diagnóstico en 9 comunidades de las provincias de Chimborazo, Bolívar y Cotopaxi 1.2 Diagnóstico Rural Participativo sobre conocimientos campesinos 1.3 Numero de Planes Anuales elaborados 2.1 Investigaciones socioeconómicas en sistema noformales de Semillas 2.2 Linea base elaborada 2.3 Mapa de la Comunidad y de los Niveles de Bienestar 2.4 Mapa de la Finca
	Mejorar la habilidad y el acceso a semillas de calidad de diversas plantas y variedades a través del diseño y la prueba de intervenciones estratégicas para literatura ecológica enfocado en botánica, multiplicación de semillas, mejoramiento local de plantas y sistemas de comunicación e intercambio de semillas	1. Grupos de Guardianes de Semillas capacitados en investigación dirigido por los agricultores y procesos de aprendizaje (ECA´s, CIAL´s) que complete los vacíos de conocimiento y aprendan nuevas habilidades para la multiplicación de semillas, mejoramiento participativo de plantas y sistemas de comunicación e intercambio de semillas 2. Probar metodologías participativas promocionando aprendizajes y acciones comunitarias para mejorar el manejo de semillas e implementar y probar		1.1 Numero de Grupos de Guardianes de Semillas formados 1.2 Número de miembros de los grupos de Guardianes de Semillas capacitados en técnicas y mejoramiento de semillas 2.1 Numero de Giras de Observación y Aprendizaje, días de campo 2.2 Numero de talleres de capacitación a nivel comunitario

Project	**Resultados Esperados** *(Los resultados son los efectos probables o logrados a corto y mediano plazo-o los cambios producidos por los productos de una intervención)*	**Productos Generados** *(Las salidas son los productos, bienes de capital y servicios que representan los resultados tangibles, medibles e inmediatos de la intervención)*	**Indicadores de producto** *(Los indicadores de producto miden y verifican la producción de los productos, es decir, los bienes y servicios que son producidos por las entradas. Tienen atributos de cantidad, calidad y de tiempo)*	
			Biodiversidad	**Bienestar**
		intercambios		
	Documentar, diseminar y promocionar aplicaciones entre los agentes de desarrollo rural (organización de agricultores, agencias de desarrollo, instituciones de investigación y los políticos) de lecciones aprendidas y presentar metodologías prometedoras para facilitar a las comunidades a promover el interés en la seguridad alimentaria a través de mejorar el manejo del sistema informal de semillas	1. Documentar y diseminar lecciones aprendidas y nuevas metodologías s de Guardianes de Semillas		1.1 Numero de promotores y líderes de las comunidades locales formados 1.2 Documentos sobre las experiencias campesinas en fincas integrales 1.3 Biblioteca Mínima del Ambiente 1.4 Guía para la capacitación de técnicos y promotores en la sistematización de conocimientos campesinos
Removing Obstacles to Direct Private-Sector Participation in In-situ Biodiversity Conservation	Fortalecer el marco regulatorio y de incentivos para la conservación privada	4. Marco regulatorio y de incentivos	1.1 Documento "Manual Práctico de Conservación Privada", distribuido a los propietarios de las zonas piloto, las agencias de gobierno	
	To demonstrate the benefits of private conservation instruments and incentives through pilot area experiences	1. Creación y Gestión de Áreas Piloto		1.1 Planes de gestión 1.2 Contractos de facilitación de la conservación 1.3 Títulos de propiedad para el Corredor Ecológico Binacional Baritú-Tariquía transferidos a PROMETA
	To encourage and enable landowners outside of pilot sites to participate in private conservation	1. Creación de capacidad para nuevas iniciativas 2. Difusión	1.1 Número de copias del "Manual Práctico de Conservación Privada" y otros materiales visuales presentados a los propietarios clave 1.2 Numero de propietarios privados, organizaciones no gubernamentales y grupos comunitarios participan en eventos del Grupo de Conservación Privada Boliviana	2.1 Número de solicitudes de apoyo cumplidas

A Conceptual Framework for On-Farm Conservation Projects

Fact Sheet

On-farm conservation of crop diversity refers to the maintenance of crop evolution in farmers' fields, farms and landscapes that generates new potentially useful genetic variation, thus contributing to the capacity of agricultural and food systems to adapt to change. It depends on the active participation of farmers and the existence of incentives to do so. A large amount of crop diversity and associated evolutionary processes are still retained in developing countries by smallholder farmers, particularly in centers of crop domestication and diversity. Maintaining crop diversity on-farm, however, can entail important costs to farmers, often in the face of strong incentives to abandon this diversity. For this reason there is a need for interventions to support farmers in maintaining this diversity.

Crop diversity: *The number of distinct populations of a particular crop species recognized and managed by a farming household or community.*

Project intervention: *activities carried out by a project that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity.*

Outputs: *The products or processes produced by a project or intervention*

Outcome: *The result of a complex process. In the context of a project, refers to the result of the use or adoption of project outputs.*

Incentive: *An encouragement -- whether moral, persuasive or monetary -- that motivates an individual to perform an action*

Livelihood benefits: ***The private benefits*** *that farmers and their households derive directly from crop diversity maintain in their agricultural system (e.g. food security, nutrition, income, safety net, cultural identity)*

Societal benefits: ***The public benefits*** *that society derives from the biodiversity maintained in an agricultural system (e.g. ecosystem services, adaptive evolutionary processes)*

Evolutionary services *refer to all of the uses or services to humans produced from evolutionary processes that contribute to maintain options open to benefit from biodiversity*

In the last 20 years many projects to support on farm conservation have been implemented worldwide. However there has been very little systematic assessment of the extent to which these projects have actually produced on-farm conservation outcomes in terms of maintaining or increasing crop diversity on-farm (including farmers' knowledge and practices that underpin this diversity) as well as of livelihood outcomes that create benefits for farmers. The factors and interrelationships involved in on-farm conservation are complex, so that a conceptual scheme that brings them together in a simplified but coherent fashion can be extremely useful for scientists, donors, policy makers and practitioners involved in on-farm projects to design and assess the success of their projects in a more systematic way.

The McKnight Foundation-funded project entitled *Assessing the Success of On-Farm Conservation Projects in Delivering Conservation*

and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools was coordinated and implemented by Bioversity International. The project was carried out between March 2010 and May 2012 to develop and test the conceptual and methodological tools that are necessary for the effective assessment of project success. One of the results of this project is a conceptual framework for analyzing and measuring the extent to which interventions by projects aimed at supporting on-farm conservation deliver relevant conservation and livelihood outcomes. This model outlines the way in which outputs from projects can lead to impact and can then be adapted to a range of different projects. This conceptual tool should allow scientists, donors, policy makers and practitioners involved in on-farm conservation projects to design more effective projects and to reflect systematically on the lessons learned.

A simple model of impact for an on-farm conservation project

Any project aimed at the on-farm conservation of crop diversity intends to influence outcomes in three areas: (1) the crop diversity maintained in an agricultural system, (2) the private benefits that farmers and their households derive from that agricultural system (food security, nutrition, income, safety net, cultural identity), and (3) the public benefits that society derives from the crop diversity maintained in an agricultural system (option values derived from crop evolution). For any farming household or community, in theory, we could map its position in the three outcomes.

Figure 1a maps the position of a farming community with respect to the crop diversity it maintains and the private benefits it derives (point A). Since agricultural systems are not static, the position of a community in this graph changes, moving to the southeast of the graph under economic development, assuming that livelihood benefits increase with increased specialization, but with a concomitant decrease in the level of crop diversity (point B). This could be seen as the conventional view of the relationship between crop diversity and agricultural change that assumes a trade-off between these two outcomes. It should be stressed that we are not assuming a causal relationship between these two outcomes, but just representing a trend that is commonly assumed. The actual causal relationship is complex and contextual.

Figure 1a

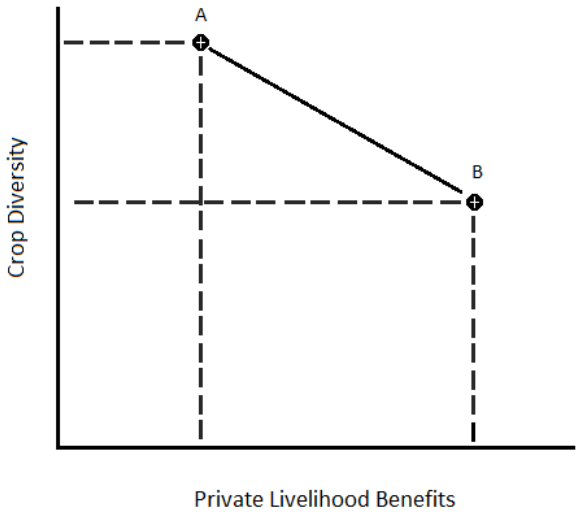
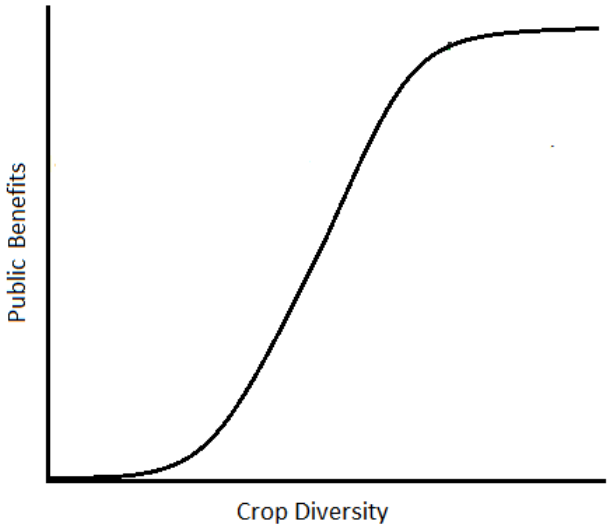


Figure 1b presents a hypothetical relationship between a metric that summarizes the level of crop diversity present in an agricultural system and the public benefits that this diversity generates, such as the option values associated with maintaining crop evolutionary processes (evolutionary services).

Figure 1b



Obviously, this relationship is quite complex and we know very little about the actual functional form that may relate these two

outcomes, but for argument's sake we assume a sigmoid shape. There may not be benefits relevant for humans below a minimum threshold of crop diversity. Once this threshold is passed then additional diversity contributes positively to the evolutionary services generated by crop diversity, but probably at a decreasing rate up to a point where no additional benefits are produced and a plateau is reached.

Assuming compatible scales in the crop diversity metric in both figures, Figure 1a can be flipped by 90 degrees to the left in order to align the crop diversity axis with Figure 1b, resulting in Figure 2a that connects the three outcomes relevant for on-farm conservation.

Figure 2a

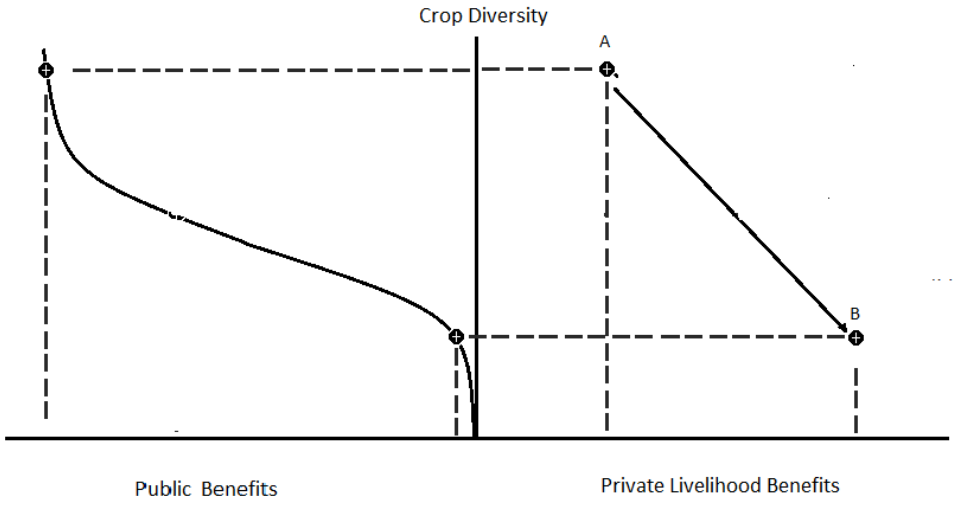
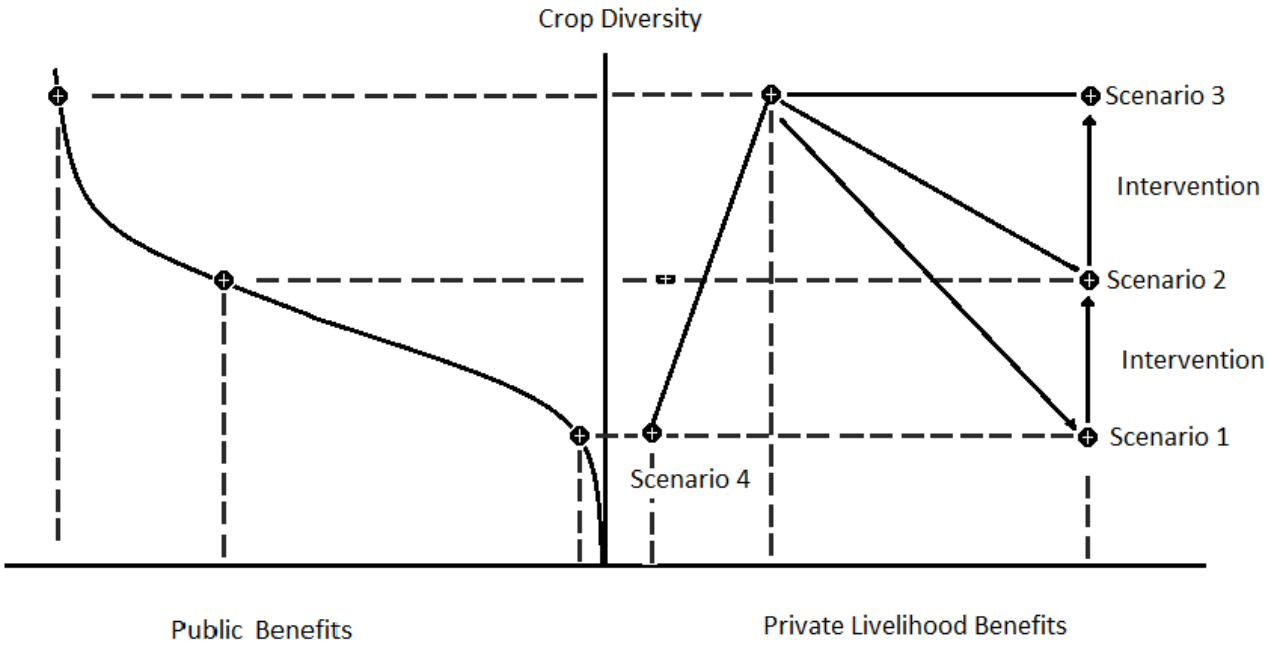


Figure 2b



Then one can map the position of a community with respect to the private livelihood benefits that it derives from crop diversity and the public benefits it contributes to society by maintaining this diversity. Figure 2a maps the trade-off described above, where economic development leads to a decrease in crop diversity, which in turn leads to a major loss of the public benefits associated with the evolutionary services generated by crop diversity.

Assuming that the increase in societal benefits is socially desirable, then interventions could be implemented to decrease the slope of the trajectory of change, shifting the relationship between livelihood benefits and crop diversity. These interventions include the introduction of new technologies, the development of capacities and skills or new forms of organization aimed at changing the way farmers and communities access, manage, use, perceive, consume and/or market crop diversity.

Figure 2b presents a series of scenarios to

illustrate how these interventions could change relationships. Scenario 1 is the same as depicted in Figure 2a, i.e. the process of change with a negative trend without any interventions, i.e. the counterfactual to the interventions.

Scenario 2 presents the situation where, while there is still a negative trend in the relationship between the crop diversity maintained by a household or a community, interventions are implemented to shift the trend upward, leading to a much reduced loss of crop diversity and hence of the associated public benefits compared to Scenario 1, particularly since the relationship between crop diversity and public benefits is non-linear and at high levels of diversity may reach a plateau, its loss may be inconsequential. This indicates that at certain levels of crop diversity present, it is possible to reduce crop diversity at little or no cost in public benefits, and hence not all loss of crop diversity may be socially unacceptable.

Scenario 3 presents a situation that many may consider ideal, where crop biodiversity is maintained at its original level, delivering all associated public benefits of crop diversity together with a major improvement in the private benefits captured by a community. Finally, Scenario 4 presents a worst-case with a trend in which both crop diversity and associated public benefits and private benefits of a community are reduced. This case may correspond to changes in the economic and social environment that lead to the abandonment of crop diversity but without any associated private benefits to the communities. For example, the introduction of a new crop leading to the total abandonment of the traditional crop in the hope of increasing income, followed by a collapse in the price or market of the former due to competition, changes in consumer tastes, or failure to produce due to the appearance of a non-controllable pest or disease.

CONCLUSIONS

The processes and outcomes associated with on-farm conservation of landraces in centers of crop diversity are complex; causality is neither clear nor obvious. The framework presented here clearly is a major simplification of these issues and their relationships yet is nevertheless valuable because it provides a scheme that allows us to reflect systematically on these issues, organize our knowledge and identify knowledge gaps and lack of understanding.

By providing interventions that link the conservation of crop diversity with improved well-being, not only are incentives created for the continued maintenance of diversity and the generation of evolutionary services, but options are provided to make the conservation process fairer by aligning the short-term private interests of farmers with society's long-term public interests. On-farm conservation as a provider of evolutionary services directly to farmers contributes to their endogenous capacity to respond to change while maintaining the structure and functioning of their agricultural systems, hence their resilience. The implementation of successful projects supporting on-farm conservation should enable farmers and their agricultural systems to remain sustainable and resilient by providing them with tools that enhance their capacity to face change under conditions of uncertainty.

The framework presented here provides a conceptual tool that allows scientists, donors, policy makers and practitioners involved in on-farm conservation projects to identify gaps, lack of understanding and organize the knowledge and information needed for the development of on farm conservation projects. It also provides the basis for assessing the success of these projects. It is hoped that the framework will help users design and implement better projects that maintain crop diversity more effectively and deliver higher levels of well-being to the farmers who maintain it.

This fact sheet was produced by Mauricio Bellon, Elisabetta Gotor and Francesco Caracciolo. For further information, please contact Dr Mauricio Bellon, Bioversity International Principal Scientist, at m.bellon@cgiar.org

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Un marco conceptual para proyectos de conservación en finca

Hoja Divulgativa

La conservación en finca de la diversidad de cultivos se refiere al mantenimiento de la evolución de un cultivo en los campos, fincas y paisajes manejados por agricultores que genera nueva variación genética potencialmente útil, contribuyendo así a mantener la capacidad de adaptación de los sistemas agrícolas y de alimentación al cambio. Esto depende de la participación activa de los agricultores y la existencia de incentivos para hacerlo. Muchos pequeños agricultores en países en desarrollo continúan manteniendo una gran diversidad de cultivos—y procesos evolutivos asociados—en sus centros de diversidad y domesticación. Sin embargo, mantener la diversidad de cultivos en finca, puede entrañar costos a los agricultores, ya que a menudo existen fuertes incentivos para abandonar esta diversidad. Debido a esto, existe la necesidad de intervenciones para apoyarlos a mantener esta diversidad. En los últimos 20 años muchos proyectos para apoyar la conservación en finca han sido implementados a nivel mundial. Sin embargo, ha habido muy poca evaluación sistemática de hasta qué punto estos proyectos han producido realmente los resultados esperados en términos de mantener o incrementar la diversidad de cultivo en finca (incluyendo los conocimientos y prácticas que la sustenten) así como también en los medios de vida de los agricultores, creando así beneficios para ellos. Los factores e interrelaciones involucradas en la conservación en finca son complejos, por lo que un esquema conceptual que los reúna de una forma simple pero coherente puede ser extremadamente útil para científicos, donantes, formuladores de políticas y profesionales involucrados en este tipo de proyectos con el objeto de diseñar y evaluar el éxito de sus proyectos de una forma más sistemática.

Diversidad de cultivo: *El número de distintas poblaciones de una especie cultivada reconocida y gestionada por un hogar agrícola o una comunidad.*

Intervención del proyecto: *actividades llevadas a cabo por un proyecto que suministran a los agricultores involucrados, innovaciones como nuevas tecnologías, desarrollo de capacidades y habilidades o nuevas formas de organización orientadas a cambiar la forma como ellos acceden, gestionan, usan, perciben, consumen y/o mercadean la diversidad de cultivo.*

Productos: *los productos o procesos producidos por un proyecto o intervención.*

Resultado: *el resultado de un proceso complejo. En el contexto de un proyecto, se refiere al resultado del uso o adaptación a los productos del proyecto.*

Incentivo: Fomentar – sea de forma moral, persuasiva o monetaria – que motiva a alguien a realizar una acción.

Beneficios de medios de vida: ***Los beneficios privados*** *que los agricultores y sus hogares derivan directamente de la diversidad de cultivos mantenida en su sistema agrícola (es decir, seguridad alimentaria, nutrición, ingreso, red de seguridad, identidad cultural)*

Beneficios sociales: los bene*ficios públicos* *que la sociedad deriva de la diversidad de cultivo mantenida en un sistema agrícola (es decir, servicios ecosistémicos, procesos evolutivos adaptativos)*

Servicios evolutivos *se refiere a todos los usos o servicios que los seres humanos derivan de los procesos evolutivos, y que mantienen opciones abiertas para beneficiarse de la biodiversidad.*

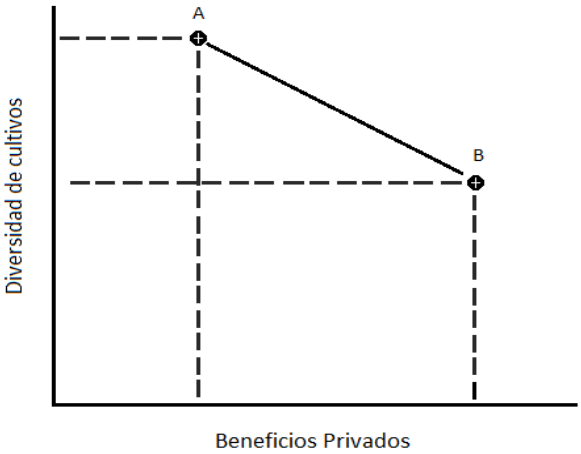
El proyecto de la La Fundación McKnight titulado *Evaluando el Éxito de los Proyectos de Conservación en Finca para Suministrar Resultados de Conservación y Medios de Vida: Identificando Mejores Practicas y Herramientas de Apoyo en la Toma de Decisiones* fue coordinado e implementado por Bioversity International. El proyecto fue llevado a cabo entre marzo de 2010 y Mayo de 2012 para desarrollar y probar herramientas conceptuales y metodológicas útiles para la evaluación efectiva del éxito de este tipo de proyectos. Uno de los resultados de este proyecto es un marco conceptual para analizar y medir el grado en que las intervenciones de proyectos orientadas a apoyar la conservación en finca ofrecen resultados relevantes en conservación y medios de vida. Este modelo representa la forma en que los productos de los proyectos pueden generar impacto. El modelo que puede ser adaptado a una variedad de proyectos distintos. Esta herramienta conceptual debe permitir a los científicos, donantes, formuladores de políticas y profesionales involucrados en este tipo de proyectos mejorar su diseño y poder reflexionar sistemáticamente sobre las lecciones aprendidas.

Un modelo de impacto simple para un proyecto de conservación en finca

Cualquier proyecto orientado a la conservación en finca de la diversidad de cultivo tiene la intención de influenciar resultados en 3 áreas: (1) la diversidad de cultivo mantenida en un sistema agrícola, (2) los beneficios privados que los agricultores y sus hogares derivan del sistema agrícola (seguridad alimentaria, nutrición, ingreso, red de seguridad, identidad cultural) y (3) los beneficios públicos que la sociedad deriva de la diversidad de los cultivo mantenidas en un sistema agrícola (valores de opción derivados de la evolución del cultivos). Para cualquier hogar agrícola o comunidad, en teoría, se puede identificar su posición en estas 3 áreas.

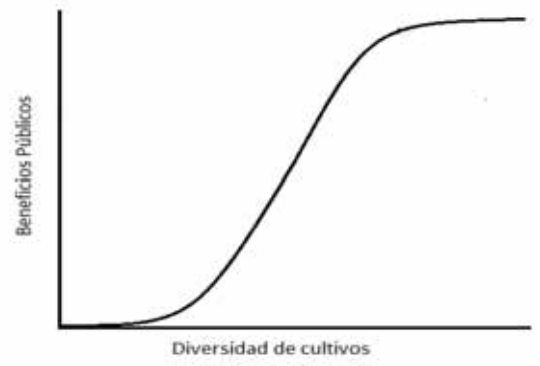
La figura 1a identifica la posición de una comunidad de agricultores con respecto a la diversidad de cultivo que mantiene y los beneficios privados que deriva (punto A). Como los sistemas agrícolas no son estáticos, la posición de una comunidad en esta gráfica cambia, moviéndose hacia el sureste del gráfico debido al desarrollo económico, suponiendo que los beneficios privados de los agricultores aumentan con mayor especialización, pero llevando a una reducción en el nivel de diversidad de cultivo mantenido (punto B). Esta es la visión convencional de la relación entre la diversidad de cultivo y el desarrollo agrícola, que asume una disyuntiva entre ambos.

Figure 1a



Es importante destacar que no estamos suponiendo una relación causal entre estos 2 resultados, solo representando una tendencia que es comúnmente asumida. Esta relación causal es compleja y contextual. La figura 1b presenta una relación hipotética entre una métrica que resume el nivel de la diversidad de cultivo presente en un sistema agrícola y los beneficios públicos que esta diversidad genera, como los valores de opción asociados con el mantenimiento de los procesos evolutivos del cultivo (servicios evolutivos). Obviamente, esta relación es compleja y se sabe poco sobre la forma funcional que relaciona estos dos resultados, pero a modo de argumento suponemos una forma sigmoide.

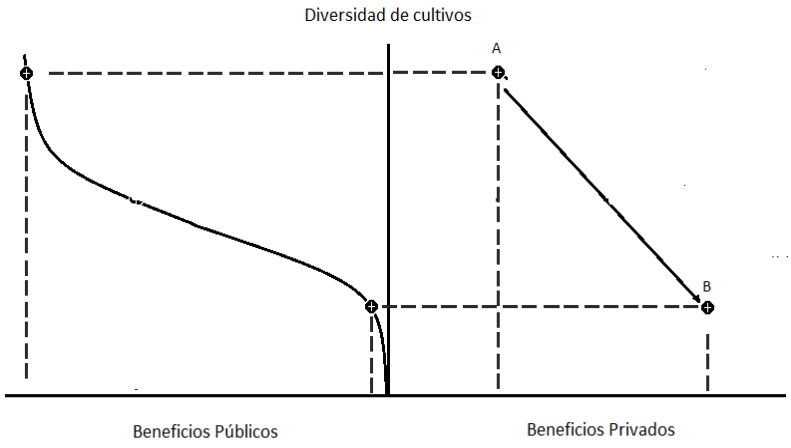
Figure 1b



Por debajo de un umbral mínimo de diversidad, puede que no existan beneficios relevantes para los humanos. Sin embargo, una vez que se pasa este umbral, la diversidad adicional contribuye positivamente a los servicios evolutivos generados por la diversidad de cultivo, pero probablemente a una tasa decreciente, hasta el punto donde no se producen beneficios adicionales y se llega a un nivel de estancamiento.

Suponiendo escalas compatibles en la métrica de diversidad de cultivos en ambas figuras, la figura 1a puede ser invertida en 90 grados a la izquierda para alinear el eje de la diversidad de cultivos con la de la figura 1b, resultando en la figura 2a que conecta las 3 áreas relevantes para la conservación en finca.

Figure 2a

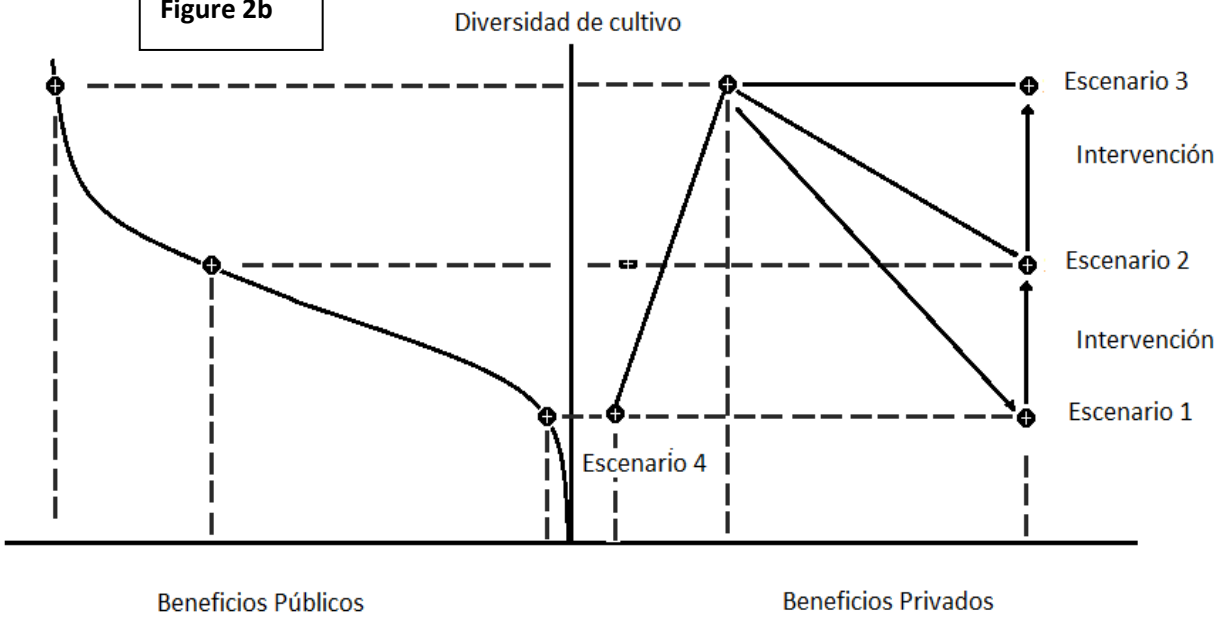


Se puede definir entonces la posición de una comunidad con respecto a los beneficios de los privados derivados de la diversidad de cultivo y de los beneficios públicos para la sociedad resultado de mantener esta diversidad. La figura 2a define el equilibrio descrito arriba, donde el desarrollo económico lleva a un detrimento en la diversidad de cultivo, lo que a su vez lleva a una pérdida de los beneficios públicos asociados con los servicios evolutivos generados por la diversidad de cultivos.

Suponiendo que el aumento en los beneficios sociales es socialmente deseado, entonces se pueden implementar intervenciones para disminuir la pendiente de la trayectoria de cambio, moviendo hacia arriba la relación entre los beneficios privados y la diversidad de cultivos. Estas intervenciones incluyen la introducción de nuevas tecnologías, el desarrollo de capacidades y habilidades o nuevas formas de organización orientadas a cambiar la manera como los agricultores y las comunidades acceden, manejan, usan, perciben, consumen y/o mercadean la diversidad de cultivos.

La figura 2b presenta una serie de escenarios para ilustrar como estas intervenciones podrían cambiar estas relaciones. El escenario 1 es el mismo que se indica en la figura 2a, es decir, el proceso de cambio con una tendencia negativa, sin

Figure 2b



intervención alguna, es decir, el punto de referencia de las intervenciones.

El escenario 2 presenta la situación en donde, mientras todavía existe una tendencia negativa en la relación entre la diversidad de cultivos mantenida por un hogar o una comunidad, se llevan a cabo intervenciones para cambiar la trayectoria descendente, aminorando de esta manera la reducción en la diversidad de cultivo y por ende en los beneficios públicos asociados, comparado con el escenario 1. Debido a que la relación entre la diversidad de cultivos y los beneficios públicos no es lineal y que a altos niveles de de diversidad de cultivos, los beneficios públicos pueden alcanzar un nivel de estancamiento, su pérdida puede ser poco consecuente. Esto indica que a ciertos niveles de diversidad de cultivo, es posible reducir esta diversidad con poco o sin costo alguno en beneficios públicos, y por lo que no todas las pérdidas de diversidad de cultivo pueden ser socialmente inaceptables.

El escenario 3 presenta una situación que muchos pueden considerar ideal, donde la diversidad de cultivo es mantenida en su nivel original, generando todos los beneficios públicos asociados junto con un mayor bienestar para la comunidad. Finalmente, el escenario 4 presenta el peor de los casos con una trayectoria en la cual la diversidad de cultivos y los beneficios públicos asociados y los beneficios privados de una comunidad se reducen. Esto podría corresponder a cambios en el ambiente económico y social que llevna al abandono de la diversidad de cultivos pero sin ningún beneficio privado asociado. Por ejemplo, la introducción de un nuevo cultivo, que lleve al abandono total del cultivo tradicional con la esperanza de aumentar el ingreso, seguido por un colapso en el precio de venta dada una mayor competencia, a cambios en los gustos de los consumidores, o a problemas de producción por la aparición de plagas o enfermedades no controlables.

CONCLUSIONES

Los procesos y resultados asociados con la conservación en finca de las variedades nativas en centros de diversidad de cultivos son complejos; su causalidad no es ni clara ni obvia. El marco presentado aquí es claramente una simplificación de estos temas y sus relaciones, sin embargo el esquema presentado aquí puede ser valioso ya que permite reflexionar sistemáticamente sobre estos temas, organizar nuestro conocimiento, así como identificar brechas de conocimiento.

Suministrar intervenciones que conecten la conservación de la diversidad de cultivo con el mejoramiento en el bienestar de los agricultores, no solo crea incentivos para que esta diversidad se mantenga y continúe generando servicios evolutivos, sino que contribuye a hacer los procesos de conservación mas equitativos, al alinear los intereses privados a corto plazo de los agricultores con los intereses públicos a largo plazo de la sociedad.

El marco aquí presentado presenta una herramienta conceptual que permite a los científicos, donantes, formuladores de políticas y profesionales involucrados en los proyectos de conservación en finca identificar brechas, falta de entendimiento y organizar el conocimiento y la información necesaria para el desarrollo de proyectos de conservación en finca, así como para la evaluación de sus logros. Se espera que este marco les ayude a diseñar e implementar mejores proyectos que conserven la diversidad de manera más efectiva y que a su vez generen mayores niveles de bienestar para los agricultores involucrados.

Esta hoja divulgativa fue producida por Mauricio Bellon, Elisabetta Gotor y Francesco Caracciolo. Para mayor información, por favor contactar a Dr Mauricio Bellon, Bioversity International Cientifico Principal, al correo m.bellon@cgiar.org

Noviembre 2012

Guidelines and Best Practices for On-Farm Conservation Projects:

Designing and Evaluating Interventions

Fact Sheet

The objective of on-farm conservation is to maintain crop evolution and thus ensure the generation of new potentially useful genetic variation in order to sustain the capacity of agricultural and food systems to adapt to change. Maintaining crop diversity on-farm, however, can entail important costs to farmers, often in the face of strong incentives to abandon this diversity. For this reason there is a need for projects to support farmers in maintaining this diversity. The success of any on-farm conservation project depends on a good design that brings together four aspects: (1) crop diversity, (2) the private benefits associated with its use; (3) the societal/public benefits associated with its maintenance; (4) the interventions/innovations needed to link these three areas in a positive and coherent way. In order to do this, we propose a set of guidelines for project design based on the results of the McKnight Foundation-funded project entitled *Assessing the Success of On-Farm Conservation Projects in Delivering Conservation and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools* coordinated and implemented by Bioversity International and carried out between March 2010 and May 2012 in the High Andes of Ecuador, Bolivia and Peru. These guidelines should assist the project implementer in formulating, step-by-step, a sound and solid theory of change that will lead to the achievement of impact.

Crop diversity: *The number of distinct populations of a particular crop species recognized and managed by a farming household or community. It could include measures of population size such as area or quantity of seed planted per distinct population.*

Livelihood benefits: *The private benefits that farmers and their households derive from that agricultural system (e.g. food security, nutrition, income, safety net, cultural identity)*

Societal benefits: *The public benefits that society derives from the relevant components of biodiversity maintained in an agricultural system (e.g. ecosystem services, adaptive processes)*

Project interventions: : *Activities carried out by a project that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity.*

Step-by-Step for a Successful Project:

1. *Decide which area to target*

A distinguishing feature of an on-farm conservation project is the focus on delivering public benefits associated with the maintenance of crop diversity. Locating a project in an area with a high potential for delivering these types of benefits is crucial, e.g. a center of infra-specific diversity for a crop or a hotspot of co-occurrence of many relevant crops. But even if those benefits exist, the value of implementing projects may still depend on how unique and globally relevant the crop diversity is and the extent to which there are other projects already addressing these benefits in the area (to avoid duplication and waste of resources, but also to be able to learn from those other projects).

2. *Collect diagnostic data*

The next step is to assess whether farmers in the target area are deriving private benefits from crop diversity, which farmers are doing so, and what the trends are in the provision of these benefits (are they continuing, decreasing, increasing?). In many locations farmers already continue to maintain crop diversity without any outside intervention (known as *de facto* conservation). However, there is no assurance that this may continue in the future and hence there may be a need for outside interventions. For this it is necessary to have a good

diagnosis of the incentives for farmers to use and maintain crop diversity. This requires collecting diagnostic data on the level and management of native species diversity *in situ* and *ex situ* as well as on socio-economic issues, focusing on the use of target species in the research area. Diagnostic data therefore include: a literature review or empirical studies of local diversity status and use; socio-economic surveys; and key informant interviews.

3. Assess the potential for success

If the evidence from diagnostic data indicates that an involvement is desirable, then there is a need to assess *ex ante* whether there are interventions that can be implemented to enhance the incentives that farmers have to use and maintain crop diversity. This is a prospective assessment for identifying the areas where change is needed (areas of intervention), the types of change (interventions) needed and their potential of success based both on the diagnosis and on knowledge from other studies. There are two broad types of potential interventions: (a) those that build on farmers' preferences and actions related to improving production, consumption, and marketing; and (b) those driven by external actions, such as payments for agro-biodiversity services (PACS) or regional or national policies (e.g. eliminating subsidies, promoting purchase programs, etc.)

4. Identify interventions to implement

Once the areas and general types of interventions have been identified, these must be narrowed down to specific activities that need to be undertaken to enhance the incentives that farmers have to use and maintain crop diversity. These activities are the core project interventions aimed at changing the way native crop diversity is managed, used, consumed and marketed to increase the benefits farmers and their households derive (livelihoods) and hence to create the incentives for farmers to continue to maintain this diversity on-farm (conservation). It is likely that several areas of intervention may have to be addressed and therefore there may be a "basket" of interventions in a project. These interventions need to have a clear **theory of change** (see the figure on p.4), which is a narrative describing **why** an intervention is needed, **what** is expected to be changed due to the intervention and **how** the change(s) is/are supposed to have an effect on crop diversity and well-being.

5. Define expected outputs, methodology and partnerships

Project interventions require the development of specific outputs, i.e. novel knowledge, methods, technologies, or forms of organization to be used by project beneficiaries or target groups to generate the envisioned change (therefore can also be conceptualized as innovations provided by a project). Some of these outputs will be related more to diversity, others more to livelihoods, but they have to be complementary. Once the specific interventions have been identified then there is a need to clearly define how desired change to the current situation can be accomplished, i.e. the **methodology** to be used. Once the different interventions and methods have been defined, there is a need to set up a **network of partners** that will enable the project implementation. Therefore there is a need to understand which actors and institutions can influence or support the interventions and how, what their goals and eventual relationships are, and what links and channels are needed to improve collaboration.

6. Map the impact pathway

Once all these components have been defined, there is a need to develop an impact pathway, which is a logical and coherent conceptual chain of events that link all components into a process. The chain of events maps the pathway by which planned outputs are related to interventions and allows the project team to contextualize them. Interventions then are expected to lead to the application and use of the outputs (that may differ from the planned ones due to contextualization) to achieve the desired changes. These in turn should eventually lead to the desired livelihood and diversity outcomes associated with successful on-farm conservation. It is anticipated that by explicitly planning the impact pathway, researchers and partners will be better able to fine-tune the research design, establish the most effective partnerships and determine the appropriate communications activities for achieving the intended outcomes more effectively.

7. Make planning and implementation activities participatory

It is highly recommended that all the processes described here be made participatory, engaging the research team, partners and clients as a way to develop a more realistic and shared vision of the project/programme and to facilitate feedback, learning and adaptive management. Identifying (and engaging) key partners and describing intended impact pathways will help to focus

monitoring, evaluation and impact assessment activities.

8. Collect baseline data

Once information on project interventions and associated outputs, theory of change and impact pathway is available, it is fundamental to carry out the **collection of baseline data** in order to perform a sound impact assessment at the end of the project. The baseline should include indicators associated with the implementation of project interventions and the changes that they are expected to contribute to outcomes. The need to wait until project interventions are defined to carry out the baseline is important because otherwise there will be no way of knowing whether or not the interventions were effective.

9. Translate outputs to outcomes

Once project interventions are implemented, it is expected that these lead to adoption and use of outputs by the target population through **communication and dissemination activities**, in turn resulting in the desired changes (**outcomes)**, in terms of both diversity and livelihoods. Then a process to **scale out** may take place so that populations beyond the target group and stakeholders adopt project outputs through dissemination and **institutionalization** by policy makers and key stakeholders. It is fundamental at this stage to collect endline data which can be then compared to baseline data collected before implementation in order to understand and measure the changes generated by the project in diversity and livelihoods.

10. Assess impact

Through this scaling out and scaling up process, the **expected impact** and the changes that the project set out to create should be generated and the **conservation of diversity while improving livelihoods** achieved. The relevant questions that *ex ante* and *ex post* impact assessment must answer are: What are the changes at the local, national and policy levels that occurred thanks to project implementation? How did they affect diversity and livelihoods?

Conclusions

The scope of implementing a **basket of interventions** with different aims is to provide diverse and relevant "**options**" to the farmers that enhance the value of what they already have. In this regard, it is crucial to identify, develop and offer new ways of cultivating, consuming, processing and marketing the diversity of crops and animal breeds they have as a way of enhancing farmers' choices and well-being by improving their capacities and influencing the institutional environment by providing interventions that enable choice. On-farm conservation projects can be implemented around the world where there are areas of high levels of diversity of global significance, diversified livelihood strategies, intensive use of agro-biodiversity and high cultural diversity. These on-farm conservation projects, if well-designed and successful, should produce a positive cycle of increased diversity and improved well-being, resulting in the maintenance of or increase in crop diversity.

While the final goal is the same for all on-farm conservation projects (to conserve crop diversity and achieve societal benefits through incentives to farmers in the form of direct private benefits that translate into improved livelihoods), the specific interventions of these projects will vary according to the specific outputs and outcomes desired. The following diagram outlines how the decision-making process results in a successful project. The first half of the diagram illustrates the reasoning process for determining the need for an on-farm conservation project. The second half illustrates how the project design, by uniting the overall project goal with the necessary outputs and outcomes, will result in the desired impact.

This fact sheet was produced by Mauricio Bellon, Elisabetta Gotor and Francesco Caracciolo. For further information, please contact Dr Mauricio Bellon, Bioversity International Principal Scientist, at m.bellon@cgiar.org

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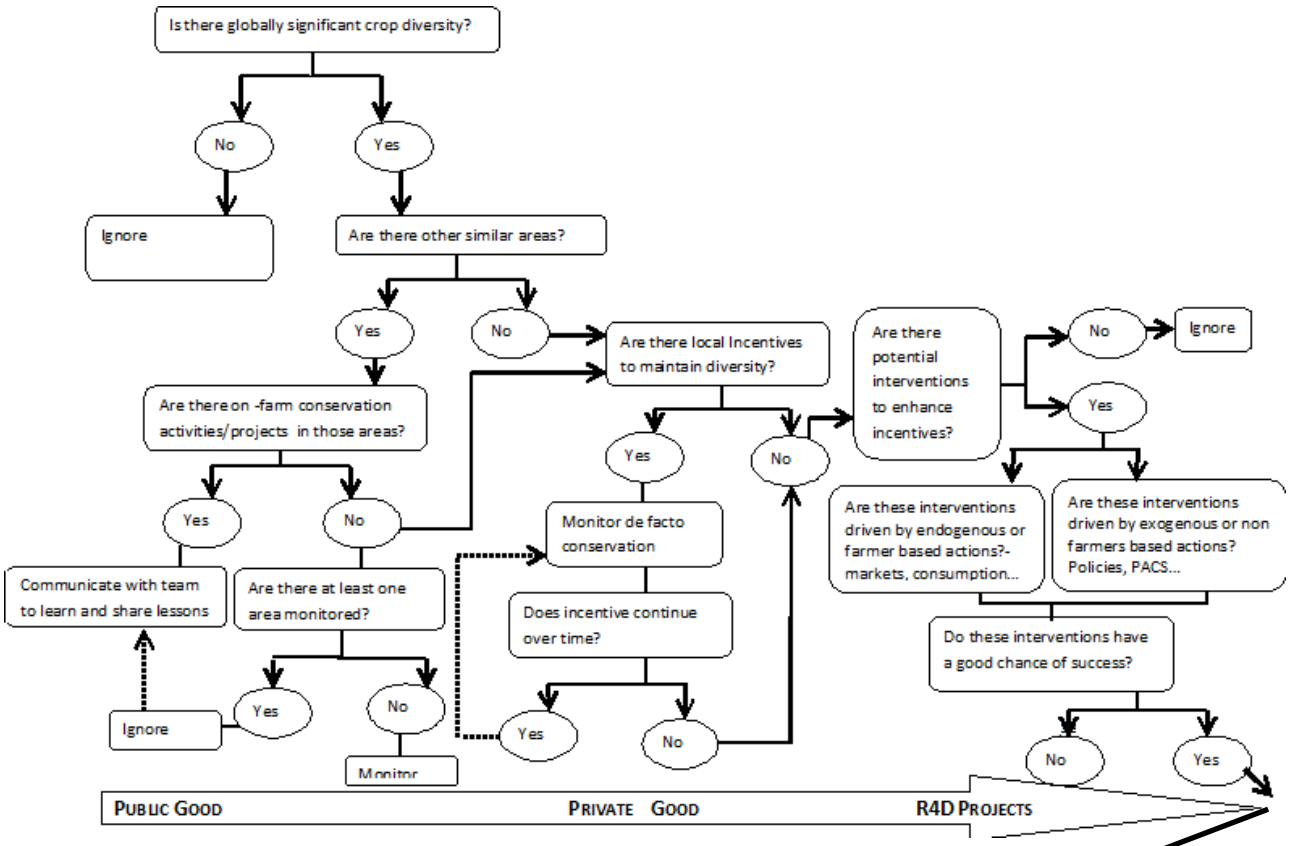
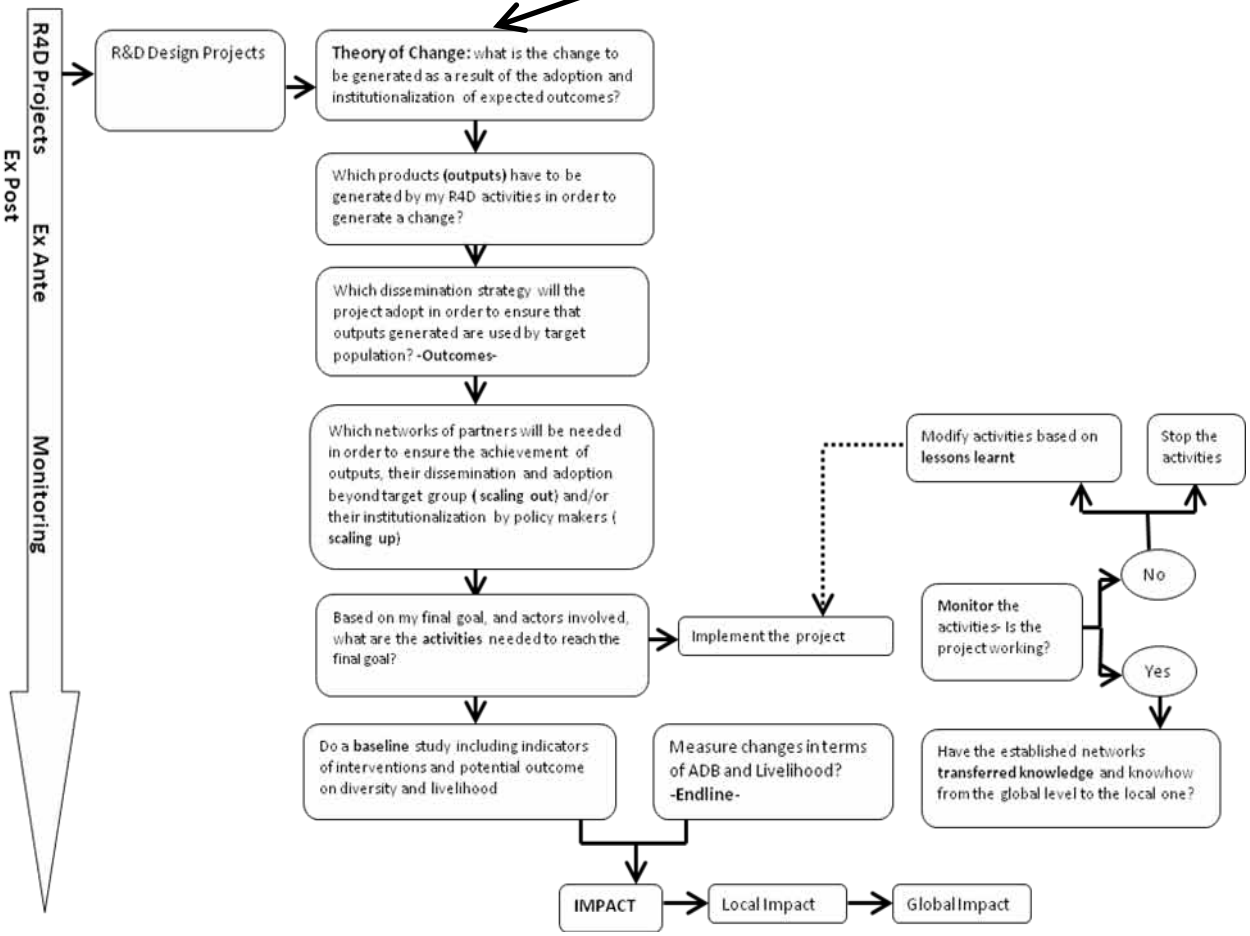


Proceed to develop the on-farm conservation project



Instrucciones y mejores prácticas para los Proyectos de Conservación en Finca:
Diseñando y Evaluando las Intervenciones

Hoja Divulgativa

El objetivo de la conservación en finca es mantener la evolución de los cultivos y por tanto asegurar la generación de nueva variación genética potencialmente útil para sostener la capacidad de los sistemas agrícolas y alimenticios para adaptarse al cambio. Sin embargo, mantener la diversidad de cultivos en finca, puede entrañar costos a los agricultores, ya que a menudo existen fuertes incentivos para abandonarla. Debido a esto, existe la necesidad de intervenciones para apoyarlos a mantener esta diversidad EL éxito de cualquier proyecto de conservación en finca depende de un buen diseño que reúna 4 aspectos: (1) la diversidad de cultivo, (2) los beneficios privados asociados con su uso; (3) los beneficios públicos/sociales asociados con su mantenimiento; (4) las intervenciones/innovaciones necesarias para conectar estas 3 áreas en una manera positiva y coherente. Con este propósito aquí proponemos una serie de instrucciones para el diseño de proyectos basado en los resultados del proyecto financiado por La Fundación McKnight titulado *Evaluando el Éxito de los Proyectos de Conservación en Finca para Suministrar Resultados de Conservación y Medios de Vida: Identificando Mejores Practicas y Herramientas de Apoyo en la Toma de Decisiones* coordinado e implementado por Bioversity International. Y llevado a cabo entre Marzo de 2010 y Mayo de 2012 en los Andes Altos de Ecuador, Bolivia y Perú. Estas instrucciones deben ayudar al implementador del proyecto a formular, paso a paso, una teoría de cambio firme y solida contribuirá al logro de impacto.

Diversidad de cultivo: *El número de distintas poblaciones de una especie cultivada reconocida y gestionada por un hogar agrícola o una comunidad*

Beneficios de medios de vida: ***Los beneficios <u>privados</u>*** *que los agricultores y sus hogares derivan directamente de la diversidad de cultivo mantenida en su sistema agrícola (es decir, seguridad alimentaria, nutrición, ingreso, red de seguridad, identidad cultural)*

Beneficios sociales: los bene*ficios <u>públicos</u>* *que la sociedad deriva de la diversidad de cultivo mantenida en un sistema agrícola (es decir, servicios ecosistémicos, procesos evolutivos adaptativos)*

Intervención del proyecto: *actividades llevadas a cabo por un proyecto que suministran a los agricultores involucrados, innovaciones como nuevas tecnologías, conocimiento, desarrollo de capacidades y habilidades o nuevas formas de organización orientadas a cambiar la forma como ellos acceden, gestionan, usan, perciben, consumen y/o mercadean la diversidad de cultivo.*

Paso a Paso para un Proyecto Exitoso:

1. *Decidir qué área tomar como objetivo*

Una característica distintiva de un proyecto de conservación en finca su enfoque en contribuir a generar beneficios públicos asociados con el mantenimiento de la diversidad de cultivo. Localizar un proyecto en un área con un alto potencial para entregar estos tipos de beneficios es crucial, por ejemplo, en un centro de diversidad infraespecífica para un cultivo o en una zona donde diversos cultivos ocurren simultáneamente. Pero aun si esos beneficios existen, el valor de implementar proyectos puede depender de que tan único y mundialmente relevante sea la diversidad de cultivos presente y el grado en que existan otros proyectos ya abordando estos beneficios en el área (para evitar duplicación y pérdida de recursos, pero también para aprender de esos otros proyectos).

2. *Recopilar datos de diagnostico*

El próximo paso es evaluar si los agricultores en el área objetivo están derivando beneficios privados de la diversidad de cultivo, quiénes lo están haciendo, y cuáles son las tendencias en la provisión de estos beneficios (continúan, están aumentando, disminuyendo?). En muchas localidades los

agricultores continúan manteniendo la diversidad de cultivo sin ninguna intervención externa (conocida como conservación *de hecho*). Sin embargo, no hay seguridad de que esto pueda continuar en el futuro y por tanto puede existir la necesidad de intervenciones externas. Por esto es necesario tener un buen diagnóstico de los incentivos que tienen los agricultores para usar y mantener esta diversidad. Esto requiere recopilar datos de diagnóstico al nivel de la gestión de la diversidad de especies nativas *in situ* y *ex situ,* así como de aspectos socioeconómicos, enfocándose en el uso de las especies de interés en el área objetivo. La información requerida para el diagnostico incluye: una revisión de literatura o estudios empíricos del estado de la diversidad local y su uso; encuestas socioeconómicas; y entrevistas con informantes claves.

3. Evaluar el potencial para el éxito

Si la evidencia del diagnostico indica que es deseable llevar a cabo un proyecto, entonces existe la necesidad de evaluar *ex ante* si existen intervenciones que pueden ser implementadas para aumentar los incentivos que los agricultores tienen para usar y mantener la diversidad de cultivos. Esto es, una evaluación prospectiva para identificar las áreas donde se necesita el cambio (áreas de intervención), los tipos de cambio necesarios (intervenciones) y su potencial de éxito, con base en el diagnóstico y en experiencias de otros estudios. Existen 2 grandes tipos de intervenciones potenciales: (a) aquellas que se construyen a partir de las preferencias y conductas de los agricultores, relacionadas con el mejoramiento de la producción, el consumo y la comercialización; y (b) aquéllas impulsadas por acciones externas, tales como pagos por servicios de agro biodiversidad (PACS) o políticas regionales o nacionales de apyo (por ejemplo, eliminación de subsidios, promoción de programas de compras, etc.)

4. Identificar intervenciones a implementar

Una vez que las áreas y los tipos generales de intervención han sido identificados, esto debe ser traducido a actividades específicas que mejoren los incentivos que los agricultores tiene para usar y mantener la diversidad de los cultivo. Estas actividades son las intervenciones núcleo del proyecto, orientadas a cambiar la manera en que la diversidad de cultivos es manejada, usada, consumida y comercializada para aumentar los beneficios que los agricultores y sus hogares derivan de ésta, creando así incentivos para que ellos la continúen manteniendo. Es probable que se requiera abordar varias áreas de intervención, por lo que un proyecto puede implementar una "canasta" de intervenciones. Estas intervenciones necesitan tener una clara **teoría de cambio** (ver la figura en la p.4), que es una narrativa que describe **por qué** se necesita una intervención, **qué** se espera que cambie debido a la intervención y **cómo** se supone que el los cambios deben tener un efecto sobre la diversidad de cultivos y el bienestar.

5. Definir productos esperados, metodología y alianzas

Las intervenciones de los proyectos requieren del desarrollo de productos específicos (por ejemplo, nuevos conocimientos, métodos, tecnologías, o formas de organización a ser usadas por los beneficiarios del proyecto o grupos objetivo, para generar el cambio previsto (por tanto puede también ser conceptualizado como innovaciones suministradas por un proyecto) Algunos de estos productos estarán más relacionados con la diversidad, otros más con los medios de vida del agricultor, pero deben ser complementarios. Una vez que intervenciones específicas han sido identificadas, entonces se debe definir claramente cómo generar el cambio deseable a la situación actual, esto es la **metodología** a ser usada. Una vez que las diferentes intervenciones y métodos han sido definidos, existe se debe identificar una **red de socios** que permitirá la implementación del proyecto. Por tanto es necesario entender que actores e instituciones pueden influenciar o apoyar las intervenciones y cómo, cuáles son sus metas y relaciones, y qué vínculos son necesarios para generar y mejorar la colaboración.

6. Identificar la vía de impacto

Una vez que todos estos componentes han sido definidos, se debe desarrollar una **vía de impacto**, esto es, una cadena de eventos que vincule conceptualmente de manera lógica y coherente a todos los componentes de un proceso. La cadena de eventos identifica la vía por la cual los productos esperados se relacionan con las intervenciones y permite al equipo de trabajo contextualizarlas. Se espera entonces que las intervenciones lleven a la aplicación y uso de los productos (que puede ser diferente de lo planeado dada la contextualización) para alcanzar los cambios deseados. Esto a su vez debería llevar eventualmente a los beneficios deseados en los medios de vida de los agricultores y resultados positivos sobre la diversidad de cultivo en finca. Se espera que una planeación explícita de la vía de impacto por parte de los investigadores y socios afinará el diseño del proyecto, contribuirá a establecer alianzas más efectivas, y a una buena

estrategia de comunicación y difusión, que redunde en el logro de los resultados esperados.

7. *Planear actividades participativas*

Es muy recomendable que todos los procesos descritos aquí sean participativos, involucrando al equipo de investigación, los socios y clientes de tal manera que se desarrolle una visión compartida y realista del proyecto, y que facilite la retroalimentación, el aprendizaje y una gestión adaptativa del proceso. Identificar y comprometer a los socios clave y describir las vías de impacto, ayudarán a focalizar las actividades de monitoreo, evaluación e impacto del proyecto.

8. *Recopilar datos de referencia*

Una vez que la información de las intervenciones de los proyectos y productos esperados, la teoría de cambio y la vía de impacto estén disponibles, es fundamental llevar a cabo la **recopilación de datos de línea base** para poder hacer una evaluación de impacto solida al final del proyecto. La línea base debe incluir indicadores asociados con la implementación de las intervenciones del proyecto y los cambios esperados que contribuyan a los resultados deseados. La necesidad de esperar hasta que las intervenciones de los proyectos sean definidas para llevar a cabo la línea base es importante porque de otra manera no habrá modo de saber si las intervenciones fueron efectivas o no.

9. *Traducir productos a resultados*

Una vez que las intervenciones del proyecto sean implementadas, se espera que esto lleve a la adopción y uso de los productos proveídos por éste por parte de la población objetivo a través de actividades de **comunicación y diseminación**, a su vez resultando en los cambios deseados (**resultados**) en términos tanto de diversidad como de medios de vida. Entonces puede llevarse a cabo un proceso ampliación hacia otras poblaciones más allá del grupo objetivo y hacia otros actores interesados a través de la diseminación de los resultados del proyecto hacia formuladores de políticas y otros actores claves y eventualmente a su **institucionalización** por parte de ellos. Es fundamental a este nivel recolectar datos finales que puedan ser comparados con aquellos de la línea base para entender y medir los cambios generados por el proyecto.

10. *Evaluar el impacto*

A través de este proceso de ampliación, el **impacto esperado** y los cambios que el proyecto haya contribuido a crear, se espera lograr la **conservación de la diversidad de cultivo y a su vez una mejora en los medios de vida de los agricultores involucrados**. Las preguntas relevantes que una evaluación de impacto *ex ante* y *ex post* deben responder son: Cuáles son los cambios a nivel local, nacional y de políticas que ocurrieron gracias a la implementación del proyecto? Cómo afectaron la diversidad de cultivos y los medios de vida de los agricultores involucrados?

Conclusiones

El propósito de implementar una **canasta de intervenciones** con diferentes objetivos es proveer **una** diversidad de "**opciones"** relevantes a los agricultores—generalmente marginales—que mantienen la diversidad de cultivos en sus fincas, contribuyendo a aumentar el valor de lo que ya tienen. Con respecto a esto, es crucial identificar, desarrollar y ofrecer nuevas maneras de cultivar, consumir, procesar y comercializar la diversidad de cultivos que ellos tienen como una forma de mejorar sus opciones y su bienestar, lo cual requiere mejorar sus capacidades e influir sobre el ambiente institucional en que operan. Los proyectos de conservación en finca pueden ser implementados en áreas con altos niveles de diversidad de valor global, con agricultores que cuenten con estrategias de medios de vida diversificadas, un alto uso de agro biodiversidad y una alta diversidad cultural. Si son bien diseñados y exitosos, estos proyectos deben producir un ciclo positivo de creciente de diversidad y de mejoramiento en el bienestar de los involucrados.

Mientras que el objetivo final es el mismo para todos los proyectos de conservación en finca (conservar la diversidad de cultivos y alcanzar beneficios sociales mediante los incentivos a los agricultores en forma de beneficios directos privados que se traduzcan en mejores medios de vida), las intervenciones especificas de estos proyectos variaran de acuerdo al contexto y a los productos específicos y los resultados deseados. El siguiente diagrama define como el proceso de toma de decisiones resulta en un proyecto exitoso. La primera mitad del diagrama ilustra el proceso de razonamiento para determinar la necesidad de un proyecto de conservación en finca. La segunda mitad ilustra como el diseno del proyecto, uniendo el objetivo general del proyecto con los productos y resultados necesarios, resultarán en el impacto deseado.

Esta hoja divulgativa fue producida por Mauricio Bellon, Elisabetta Gotor y Francesco Caracciolo. Para mayor información, por favor contactar a Dr Mauricio Bellon, Bioversity International Cientifico Principal, al correo m.bellon@cgiar.org

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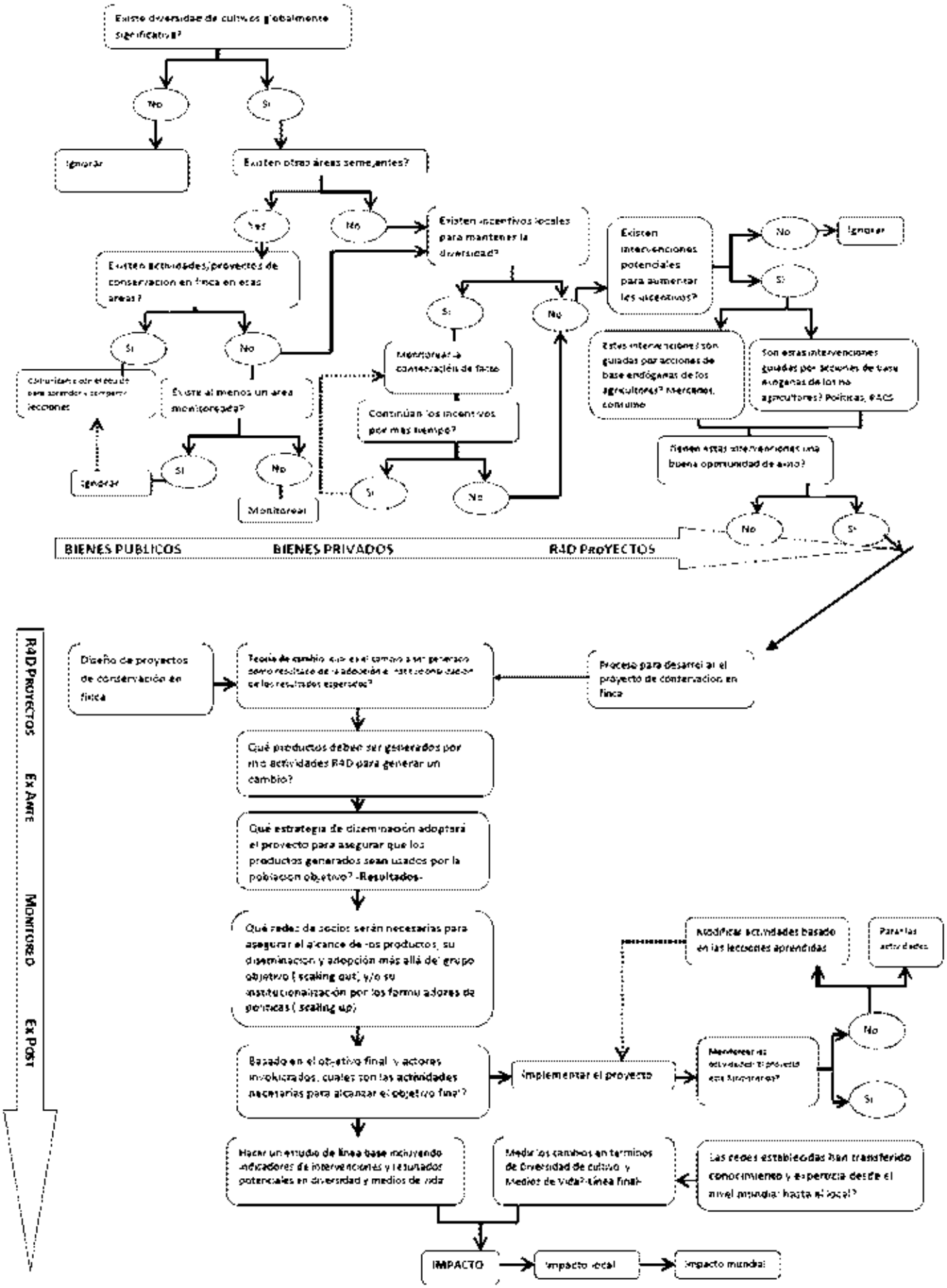

Existe diversidad de cultivos globalmente significativa?
No
Si
Ignorar
Existen otras áreas semejantes?
Si
No
Existen actividades/proyectos de conservacion en finca en esas areas?
Si
No
Existen incentivos locales para mantener la diversidad?
Si
No
Existen intervenciones potenciales para aumentar los incentivos?
No
Ignorar
Si
Estas intervenciones son guiadas por acciones de base endógenas de los agricultores? Mercados, consumo
Son estas intervenciones guiadas por sectores de base exógenas de los no agricultores? Políticas, FAOS
Existe al menos un area monitoreada?
Si
No
Ignorar
Monitorear
Monitorear la conservación de facto
Si
No
Continúan los incentivos por mas tiempo?
Si
No
Tienen estas intervenciones una buena oportunidad de éxito?
No
Si
BIENES PUBLICOS
BIENES PRIVADOS
R&D PROYECTOS
R4D Proyectos Ex Ante Monitoreo Ex Post
Diseño de proyectos de conservación en finca
Teoría de cambio que es el camino a ser generado como resultado de la adopción e institucionalización de los resultados esperados?
Proceso para desarrollar el proyecto de conservacion en finca
Qué productos deben ser generados por las actividades R4D para generar un cambio?
Qué estrategia de diseminación adoptará el proyecto para asegurar que los productos generados sean usados por la población objetivo? -Resultados-
Qué redes de socios serán necesarias para asegurar el alcance de los productos, su diseminación y adopción más allá del grupo objetivo (scaling out), y/o su institucionalización por los formuladores de políticas (scaling up)
Basado en el objetivo final y actores involucrados, cuales son las actividades necesarias para alcanzar el objetivo final?
Implementar el proyecto
Monitorear las actividades el proyecto esta funcionando?
No
Si
Modificar actividades basado en las lecciones aprendidas
Para las actividades
Hacer un estudio de línea base incluyendo indicadores de intervenciones y resultados potenciales en diversidad y medios de vida
Medir los cambios en terminos de Diversidad de cultivo y Medios de Vida?-Línea final-
Las redes establecidas han transferido conocimiento y experiencia desde el nivel mundial hasta el local?
IMPACTO
Impacto local
Impacto mundial

Methodologies for Evaluating On-Farm Conservation Projects

Fact Sheet

In the last 20 years there has been a growing interest in on-farm conservation of crop diversity. Numerous projects to support on-farm conservation have been implemented worldwide. Projects are needed because maintaining crop diversity on-farm can entail important costs to farmers, who often face strong incentives to abandon this diversity. There has been however very little systematic assessment of the extent to which these projects have actually produced on-farm conservation outcomes in terms of maintaining or increasing crop diversity on-farm (including farmers' knowledge and practices that underpin this diversity) as well as of livelihood outcomes that create benefits for farmers.

On-farm conservation of crop diversity *is the maintenance in the field of the evolutionary processes that generate new potentially useful genetic variation in crops. This depends on the active participation of farmers and the existence of incentives for them to do so.*

A major constraint has been a lack of tools allowing donors, practitioners and policy makers to measure a project's success and the extent to which these projects have actually produced desirable on-farm conservation and livelihood outcomes.

The McKnight Foundation-funded project entitled *Assessing the Success of On-Farm Conservation Projects in Delivering Conservation and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools* was coordinated and implemented by Bioversity International. The project, carried out between March 2010 and May 2012, developed a methodological and conceptual framework based on a critical review of the theoretical and empirical literature with the aim of providing donors, practitioners and policy makers with methodological tools to improve the evaluation of on-farm conservation projects.

Study Design

The study identified and examined 26 on-farm conservation projects on native crops in the High Andes of Ecuador, Peru and Bolivia, a region known as a center of origin and diversity of many important crops where smallholder farmers are the custodians of diversity. Six of these projects were studied in depth. The methods used were based on **secondary data** from reports for all projects and **primary data** obtained through key informant interviews, focus group discussions and a random sample household survey in communities targeted by the six projects.

An on-farm conservation project is conceptualized as a set of interrelated interventions that create additional benefits for farmers giving them incentives to continue to maintain crop diversity. To assess the success of on-farm conservation project work four methodological issues have to be addressed:

(1) Defining the expected conservation and livelihood outcomes that project interventions were expected to achieve;

(2) Developing measurable indicators of those outcomes;

(3) Comparing the results of applying the innovations provided by project interventions against what would have happened without applying them (counterfactual);

Project Intervention: *Activities carried out by a project that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity.*

(4) Identifying and correcting for confounding factors in the final assessment of the impact (i.e. factors that are independent of the project interventions but that can affect the outcomes, either masking or exaggerating their impacts).

Methodological Approach

The result of the study is a methodological approach that consists of both qualitative and quantitative methods of analysis and can be applied to other situations and other regions where on-farm conservation interventions are planned or needed. These methods range from desk-based research to on-site research in the field. The qualitative methods involved a review of relevant literature, key informant interviews and a social network analysis. The quantitative analysis comprised two components. One is a descriptive part based on the surveys, characterizing the households in the sample in socioeconomic terms by reporting frequencies, means and standard deviations of key relevant variables. The second component comprised an econometric analysis to test whether each of the six projects can be considered successful based on the consideration of four questions:

1) Do farmers apply the innovations provided by project interventions?

2) If so, does the application of these innovations lead to farmers maintaining levels of crop diversity higher than would have been possible without them?

3) Does this higher level of crop diversity lead to increased well-being among the households of farmers who applied the innovations?

4) Does the level of crop diversity associated with the application of innovations deliver additional evolutionary services that would not have occurred otherwise?

Answering positively to these questions will indicate that a project was presumably successful. Ideally one would assess whether the project has achieved the intended changes in the short- or medium-term and attribute these changes to the project interventions. A major consideration for this assessment is to identify the changes that would have occurred without the interventions, known as the counterfactual. Reality is dynamic and complex, with many processes taking place simultaneously and affecting each other, hence observed changes could have happened due to factors that are independent of project interventions (known as confounding factors), either masking or exaggerating project impacts and thus the need for the counterfactual as a comparison to elucidate more accurately the changes (and their magnitude) that can be properly attributed to project interventions. Establishing the counterfactual implies that we account for both observed and unobserved intervening factors and for so-called contemporaneous events. These are events that occur during the implementation of the project and that influence the outcome.

Qualitative methods

- *Review of relevant literature*
- *Key informant interviews*
- *Network analysis*
- *Focus group discussions*

Quantitative methods

- *Random stratified sampling*
- *Statistical analyses*
  - *Descriptive socioeconomic household surveys*
  - *Econometric analyses*

Literature review

A desk and internet review of 26 relevant projects focused on understanding the links between objectives, activities implemented to achieve them and diversity and livelihood outcomes. Each project was examined to understand the logical pathway that relate objectives, activities and results in order to identify commonalities from which best practices with wide applicability could be derived. Key words used in the literature search were crop diversity, on-farm conservation, biodiversity and livelihood. Project documents were analyzed and used to identify further projects for scrutiny.

For each project the review focused on identifying:

- Specific location
- Target crops
- Main donors and level of funding
- Executing organization
- Activities carried out
- Specific interventions implemented
- Outputs generated
- Crop diversity and livelihood outcomes that the project aimed to influence

- Associated indicators.

These qualitative data were analyzed and synthesized to select six projects for a more in-depth examination, which resulted in the distillation of a set of key lessons. The criteria used to select the six case studies were: (1) directly or indirectly targeting on-farm conservation; (2) funded by the McKnight Foundation or by other donors; (3) a focus on the Andean region; (4) sufficiently documented projects encompassing different situations in terms of interventions, countries, crops, social and biophysical environments

Key informant interviews

For the six selected projects, interviews with key informants—usually project leaders or scientists involved—were conducted either in person or, where that was not possible, by telephone. The purpose of the interviews was to validate and enrich the information already gathered from project reports and other documents consulted in the literature search. Informants' opinions allowed the researchers to identify gaps and strengths in specific interventions as well as lessons learned. The most effective informants were those with first-hand knowledge of the project in terms of what led to success in achieving its objectives and, likewise, what design flaws or encountered constraints limited success.

Focus group discussions

Focus group discussions were organized with groups of men and women of different ages in the communities where the selected six projects took place. The discussions elicited information on the farming system, the constraints faced and the perception of participants regarding the utility of project interventions.

Social Network Analysis

Social network analysis was used to analyze the roles, contribution and structure of the network of partners that underpinned the six projects studied in-depth. A separate fact sheet presents the methodology and how it was applied in this study.

Household surveys

Household surveys were carried out with a random sample of farming households in communities where the selected projects took place. In each location, the samples were drawn from two populations—those who participated in the project and those who did not, the latter serving as controls. The survey elicited information on indicators of project participation and application of innovations provided by interventions (adoption), relevant crop diversity and associated management, benefits associated with household wellbeing and standard socioeconomic variables, such as family demographics, education, migration, land tenure, plot quality, animal holdings, ownership of agricultural assets, access to social networks, participation in government and non-governmental programmes, participation in markets, and housing.

Statistical analyses

Socioeconomic surveys: From survey information researchers gleaned data on the number and types of interventions implemented by each project, the **rate** of participation in them, the **adoption** of associated innovations and the **usefulness rating** of these interventions, as well as data on households' socioeconomic characteristics and on the crop diversity grown by them.

Econometric analysis: In the case of the six projects analyzed, and because project interventions were not assigned randomly between treatment and control groups, there were no *a priori* control groups and no baseline available, and therefore there was a high likelihood of selection bias, which would have obscured the true relationship between adoption of innovations and conservation and livelihood outcomes. An econometric approach, the instrumental variable method, corrects for this bias and had to be used to analyze whether these projects can be deemed successful or not.

In order to carry out the econometric analysis, a set of indicators were developed for three different outcomes:

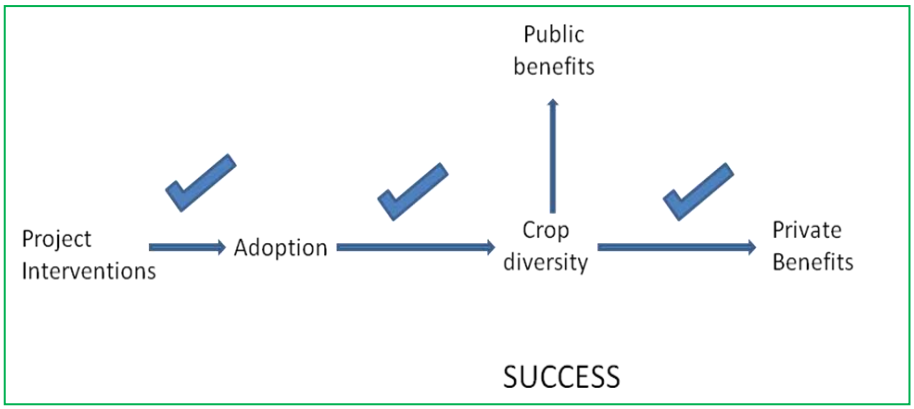
(a) Adoption of innovations provided by project interventions
(b) Crop diversity
(c) Benefits associated with household well-being.

To address the complexity of assessing three different outcomes, a simultaneous equations system was estimated, including other determinants of participation and outcomes of interest. These variables include several socio-

economic characteristics of the sample, the environment and the location of households (the confounding factors). The variables can be considered fully exogenous -- in other words, not being affected by participation. Since project interventions were many and comprise multiple aims, that is, a "basket" of interventions, the indicator used is the number of innovations provided by interventions adopted (applied) by a household. For crop diversity, the indicator was derived from the number of farmer varieties of target crops planted by households in each project, a measure of crop richness. Since in all projects there were multiple target crops, a factor analysis was performed on the number of varieties of each target crop per household in order to obtain a reliable univariate measure of crop diversity. For household benefits, in most projects the indicator was the quantity of target crops consumed and marketed by the household from its production; if prices were available, we calculated the gross revenues from marketing. In one project, however, the indicator was a life satisfaction index derived from a series of ratings on the level of satisfaction experience by the household with respect to different variables such as housing, access to education, economic activities, social life and contacts, as well as nutrition and food security.

CONCLUSIONS

The methods followed in this study allowed the researchers to conclude that a successful on-farm conservation project will display a trajectory in which participation should lead to adoption of innovations provided by project interventions resulting in increased conservation and use of crop diversity and the derivation of both public societal and private livelihood benefits, as in the following diagram:



The process depicted here may appear simplistic but this linear approximation is useful for dealing with complex processes in terms of understanding and assessing particular aspects of the issues involved.

A major contribution of this study is the mixed methods approach, which, when applied, captures the complexity of research-based and development-oriented interventions that promote the use and conservation of native crop diversity to improve farmers' well-being. The results, while assessing the success of six projects in the Andean region after their implementation (*ex post*), also emphasize the importance of an analysis of the expected outcomes to be delivered by a project before implementation (*ex ante*) to ensure that their achievement can be well-documented afterwards. Specific findings included:

- In all cases, ex ante participation was associated positively with the adoption of innovations provided by project interventions.
- In five of the six cases studied, greater adoption of innovations provided by project interventions was associated with growing more native crop diversity.
- In three cases, growing more native crop diversity was associated positively with more benefits.

The conclusions drawn from the study thus show that a careful use of appropriate methods and analytical techniques can draw information from collected data that confirm that well-designed interventions and their adoption in the field can result in increased conservation of crop diversity as well as the improvement of livelihoods and well-being. The two results are shown to be not mutually exclusive but mutually reinforcing.

This fact sheet was prepared by Mauricio Bellon, Elisabetta Gotor and Francesco Caracciolo. For further information please contact Dr Mauricio Bellon, Bioversity International Principal Scientist, at m.bellon@cgiar.org

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Metodologías para la Evaluación de Proyectos de Conservación en Finca

Hoja Divulgativa

En los últimos 20 años ha se ha desarrollado un gran interés en la conservación en finca de la diversidad de cultivos. Numerosos proyectos al respecto se han llevado a cabo a nivel mundial. Este tipo de proyectos es necesario debido a que mantener la diversidad de cultivos en finca puede implicar costos importantes para los agricultores involucrados, quienes además enfrentan fuertes incentivos para abandonar ésta. Sin embargo, ha habido una escaza evaluación sistemática del grado en que estos proyectos han producido realmente resultados tanto en términos de mantener o aumentar la diversidad de cultivos en finca (incluyendo el conocimiento de los agricultores y prácticas que la sustenten) así como de un mejoramiento en los medios de vida de los agricultores que les brinden beneficios.

La conservación en finca de la diversidad de cultivos *es el mantenimiento en el campo de los procesos evolutivos en cultivos que generan nueva variación genética potencialmente útil. Depende de la participación activa de los agricultores y la existencia de incentivos para que lo hagan.*

Una problema importante ha sido la falta de herramientas que permitan a donantes, profesionales y formuladores de políticas medir el éxito del proyecto en términos del grado en que estos proyectos han producido realmente los resultados deseados.

El proyecto financiado por la Fundación McKnight titulado *Evaluando el Éxito de los Proyectos de Conservación en Finca para Suministrar Resultados de Conservación y Medios de Vida: Identificando Mejores Practicas y Herramientas de Apoyo en la Toma de Decisiones* coordinado e implementado por Bioversity International entre Marzo de 2010 y Mayo de 2012, desarrolló un marco conceptual y metodológico basado en una revisión crítica de literatura teórica y empírica con el objetivo de proveer a donantes, profesionales y formuladores de políticas con herramientas metodológicas para mejorar la evaluación de los proyectos de conservación en finca.

Diseño del estudio

El estudio identificó y examinó 26 proyectos de conservación en finca de cultivos nativos en los Andes Altos de Ecuador, Perú y Bolivia, una región que es centro de origen y diversidad de muchos cultivos importantes, donde pequeños agricultores continúan siendo los guardianes de esta diversidad. Seis de estos proyectos fueron analizados a profundidad. Los métodos usados se basaron en **datos secundarios** obtenidos de reportes de los proyectos y **datos primarios** adquiridos a través de entrevistas con informantes clave, discusiones en grupos focales y una encuesta con una muestra aleatoria de hogares en comunidades donde los proyectos se llevaron a cabo.

Un proyecto de conservación en finca se puede conceptualizar como un conjunto de intervenciones que crean beneficios adicionales para los agricultores, dándoles así incentivos para continuar manteniendo la diversidad de cultivos. Para evaluar el éxito de un proyecto de conservación en finca se deben abordar 4 temas metodológicos:

(1) Definir los resultados esperados de conservación y sobre los medios de vida de los agricultores que las intervenciones del proyecto esperaban alcanzar;

(2) Desarrollar indicadores medibles de estos resultados;

(3) Comparar los resultados de aplicar las innovaciones suministradas por las intervenciones del proyecto contra lo que habría pasado sin aplicarlas;

Intervención del proyecto: *actividades llevadas a cabo por un proyecto que suministran a los agricultores involucrados, innovaciones como nuevas tecnologías, conocimiento, desarrollo de capacidades y habilidades o nuevas formas de organización orientadas a cambiar la forma como ellos acceden, gestionan, usan, perciben, consumen y/o mercadean la diversidad de cultivo*

(4) Identificar y corregir por factores que son independientes de las intervenciones del proyecto

pero que pueden afectar los resultados, ocultando o exagerando sus impactos.

Enfoque Metodológico

El resultado de este estudio es un enfoque metodológico que utiliza métodos de análisis tanto cualitativos como cuantitativos, y que pueden ser aplicados a otras situaciones y en otras regiones donde se planeen o requieran proyectos de conservación en finca. Estos métodos van desde la investigación documental hasta investigación en campo. Los métodos cualitativos involucraron una revisión de la literatura relevante, entrevistas con informantes clave y un análisis de redes sociales. El análisis cuantitativo comprendió dos componentes. Uno fue una parte descriptiva basada en encuestas, para caracterizar a una muestra de hogares en términos socioeconómicos, reportando frecuencias, medias y desviaciones estándar de variables clave relevantes. El segundo componente comprendió un análisis econométrico para probar si estos seis proyectos pueden ser considerados exitosos basado en respuestas a cuatro preguntas:

1) Aplican los agricultores las innovaciones suministradas por las intervenciones de los proyectos?
2) Si es así, la aplicación de estas innovaciones lleva a los agricultores a mantener niveles más altos de diversidad de cultivo de lo que habría sido posible sin éstas?
3) Este mayor nivel de diversidad de cultivos conlleva a aumentar el bienestar entre aquellos que aplicaron las innovaciones?
4) El nivel de diversidad de cultivos asociado con la aplicación de estas innovaciones genera servicios evolutivos adicionales que de otra manera no habrían ocurrido?

Una respuesta positiva a estas preguntas indica que un proyecto probablemente ha sido exitoso. Idealmente uno evaluaría si el proyecto ha alcanzado los cambios previstos en el corto – o mediano- plazo y atribuiría estos cambios a las intervenciones del proyecto. Una consideración importante de esta evaluación es identificar los cambios que hubieran ocurrido sin las intervenciones (contra factual). Dado que la realidad es dinámica y compleja, con procesos que ocurren simultáneamente y se afectan entre sí, es posible que los cambios observados pudiesen haber ocurrido por los factores que son independientes de las intervenciones del proyecto, ocultando o exagerando sus impactos. De ahí la necesidad de tener una hipótesis de comparación (contra factual) para poder dilucidar si los cambios observados y su magnitud se pueden atribuir a las intervenciones del proyecto. Establecer un contra factual implica que se tomen en cuenta tantos los factores observados como los no observados que intervienen, así como eventos que ocurren durante la implementación del proyecto y que pueden influir en el resultado.

Métodos cualitativos

- *Revisión de la literatura relevante*
- *Entrevistas con informantes clave*
- *Análisis de redes sociales*
- *Discusiones en grupos focales*

Métodos cuantitativos

- *Muestreo aleatorio*
- *Análisis estadísticos*
  - *Encuestas socioeconómicas descriptivas de hogares*
  - *Análisis econométricos*

Revisión de la literatura

Se llevo a cabo una revisión de escritorio y utilizando el internet de 26 proyectos relevantes, con el objeto de entender las relaciones entre sus objetivos, actividades implementadas y resultados sobre la diversidad de cultivos y los medios de vida los agricultores involucrados. Se examinó cada proyecto para entender la cadena lógica que relaciona los objetivos, actividades y resultados, con el objecto de dilucidar lecciones con amplia aplicabilidad. Se utilizaron las siguientes palabras clave en la busqueda de literatura: diversidad de cultivos, conservacion en finca, biodoversidad y medios de vida. Los documentos del proyecto fueron analizados para identificar los proyectos que se analizaron posteriormente en detalle.

Para cada proyecto, la revisión se enfocó en los siguientes aspectos:

- Ubicación específica
- Cultivos objetivo
- Principales donantes y nivel de financiamiento
- Organización ejecutiva
- Actividades llevadas a cabo
- Intervenciones especificas implementadas
- Productos generados

- Resultados de diversidad de cultivos y medios de vida que el proyecto se orientó a influenciar
- Indicadores asociados

Estos datos cualitativos fueron analizados y sintetizados y se seleccionaron seis proyectos que fueron analizados a profundidad y de los que se derivó una serie de lecciones. El criterio usado para seleccionar los estudios fue: (1) enfoque en la conservación en finca directa; (2) financiada por la Fundación McKnight o por otros donantes; (3) enfoque en la región Andina; (4) buena documentación disponible. Los proyectos seleccionados abarcan diferentes situaciones en términos de intervenciones, países, cultivos, ambientes sociales y biofísicos.

Entrevistas de Informantes Clave

Para los 6 proyectos seleccionados, las entrevistas con informantes clave—usualmente líderes de proyecto o científicos involucrados—fueron llevadas a cabo en persona o por teléfono. El propósito de las entrevistas fue validar y enriquecer la información obtenida de los reportes de los proyectos y otros documentos consultados. Las opiniones de los informantes permitieron identificar brechas y fortalezas asi como tambien lecciones aprendidas. Los mejores informantes fueron aquellos con conocimiento de primera mano sobre el proyecto, tanto en términos de los factores que contribuyeron a alcanzar sus objetivos, así como sobre defectos en el diseño o problemas encontrados.

Discusiones en grupos focales

Las discusiones en grupos focales fueron organizadas con grupos de hombres y mujeres de diferentes edades en las comunidades donde los seis proyectos seleccionados se llevaron a cabo. Las discusiones evocaron información sobre el sistema agrícola, los problemas afrontados y la percepciónde los participantes con relación a la utilidad de las intervenciones del proyecto.

Analisis de las redes sociales

El análisis de redes sociales fue usado para analizar los roles, la contribución y estructura de las redes de socios en la que se basaron los seis proyectos estudiados. Una hoja divulgativa separada presenta la metodologia y cómo fue aplicada en este estudio.

Encuestas en hogares

Las encuestas se hicieron con una muestra aleatoria de hogares de agricultores en comunidades donde los proyectos seleccionados se llevaron a cabo. En cada lugar, las muestra se obtuvieron de dos poblaciones—aquellos que participaron en el proyecto y aquellos que no, los ultimos sirviendo como control. La encuesta evocó información sobre: indicadores de participación en el proyecto y la aplicación de innovaciones suministradas por éste (adopción); diversidad de cultivo relevante y de su manejo; beneficios asociados con el bienestar del hogar; y variables socieconomicas estándar tales como demografía, educacion, migración, tenencia de la tierra, calidad de los campos, animales domésticos, propiedad de activos agrícolas, acceso a redes sociales, participación en programas gubernamentales y no gubernamentales, participación en mercados, y tipo de vivienda.

Análisis estadísticos

Entrevistas socieconomicas: A partir de los datos de la encuesta, los investigadores obtuvieron el número y los tipos de intervenciones implementadas por cada proyecto, la **tasa** de participación en éstas, la tasa de **adopción** de las innovaciones asociadas y la **tasa de utilidad** percibida por los participantes con respecto de cada intervención, asi como estadísticas descriptivas sobre las características socieconómicas de los hogares y de la diversidad cultivada por ellos.

Análisis econométrico: En el caso de los proyectos analizados y dado que las intervenciones de éstos no fueron asignadas aleatoriamente entre tratamiento y grupos de control, no existieron grupos de control *a priori*, ni una línea base disponible, existe una alta probabilidad de sesgos de selección. Esto puede obstaculizar el discernir la relación entre adopción y los resultados esperados sobre los medios de vida del agricultor. Por lo que se utilizó un enfoque econométrico—el método de variables instrumentales—para corregir estos sesgos.

Para llevar a cabo el análisis econométrico, un grupo de indicadores fueron desarrollados para analizar resultados en tres áreas:

(a) Adopción de innovaciones suministradas por las intervenciones de los proyectos
(b) Diversidad de cultivos
(c) Beneficios asociados con el bienestar de los hogares

Dada la complejidad para evaluar estos tres resultados, se estimo un sistema de ecuaciones simultáneas, incluyendo otros determinantes de

participación y factores de interés. Estas variables incluyen varias características socioeconómicas de la muestra, el ambiente y la ubicación de los hogares, las cuales pueden ser consideradas exógenas – en otras palabas, no son afectadas por la participación. Como las intervenciones de los proyectos fueron muchas y con múltiples objetivos, esto es, conformaron una "canasta" de intervenciones, el indicador usado fue el número de innovaciones suministrada por las intervenciones adoptadas (aplicadas) por un hogar. Para la diversidad de cultivos, el indicador fue derivado del número de variedades nativas para cada cultivo sembrado por hogares en cada proyecto, en realidad una medida de riqueza de cultivos. Como en todos los proyectos existieron múltiples cultivos se llevó a cabo un "análisis de factores" sobre el número de variedades de cada cultivo para obtener una medida en una sola variable de esta diversidad. El indicador utilizado para los beneficios de los hogares en la mayoría de los proyectos fue las cantidades consumidas y comercializadas de los cultivos relevantes por parte del hogar a partir de la propia producción; en caso de disponibilidad de precios, se calcularon los ingresos brutos a partir de la venta. Sin embargo en un proyecto, el indicador fue un "índice de satisfacción de vida" derivado de una serie de puntuaciones en el nivel de satisfacción experimentada por los hogares con respecto a distintas variables tales como vivienda, acceso a la educación, actividades económicas, vida social y contactos, así como nutrición y seguridad alimentaria.

CONCLUSIONES

Los métodos seguidos en este estudio permitieron a los investigadores concluir que un proyecto exitoso de conservación en finca mostrará una trayectoria en la cual la participación en un proyecto lleva a la adopción de innovaciones suministradas por las intervenciones de éste, resultando a su vez en un aumento en la conservación y uso de la diversidad de cultivos y en la generación de beneficios privados para el agricultor y beneficios públicos para la sociedad como se muestra en el siguiente diagrama:

El proceso aquí descrito puede parecer simplista, pero una aproximacion lineal es útil para lidiar con procesos complejos con el objeto de entender y evaluar aspectos concretos.

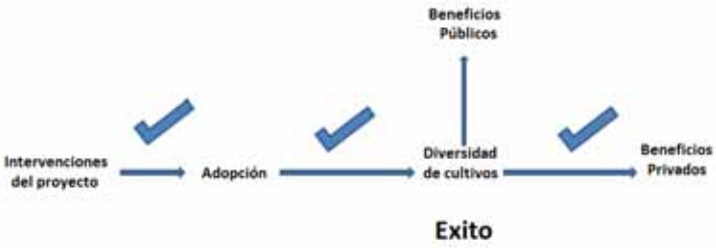
Una contribución importante de este estudio es el uso de un enfoque de utiliza métodos diversos, permitiendo capturar la complejidad de las intervenciones de proyectos basados en investigación pero con objetivos de desarrollo, como los aquí presentados. Aún cuando este estudio se baso en un análisis de los proyectos posterior a su implementación (*ex post*), también subraya la importancia de hacer un análisis previo a la implementación sobre los resultados esperados (ex ante) para asegurar que sus logros puedan ser bien documentados. Los resultados específicos son:

- En todos los casos, la participación *ex ante* estuvo asociada positivamente con la adopción de innovaciones suministradas por las intervenciones de los proyectos.

- En cinco de los casos, una mayor adopción de estas innovaciones estuvo asociada con una mayor diversidad de cultivos nativos.

- En tres casos, una mayor diversidad de cultivos nativos estuvo asociado positivamente con más beneficios para el hogar

Los resultados muestran que es posible evaluar el éxito de proyectos de conservación en finca con un uso cuidadoso de métodos y técnicas analíticas apropiadas .



Esta hoja divulgativa fue producida por Mauricio Bellon, Elisabetta Gotor y Francesco Caracciolo. Para mayor información, por favor contactar a Dr Mauricio Bellon, Bioversity International Cientifico Principal, al correo m.bellon@cgiar.org

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Network Analysis for Evaluating On-Farm Conservation Projects

Fact Sheet

On-farm conservation projects, as well as most projects that use research to foster development, usually involve multiple partners who play different roles, bring diverse perspectives and influence the project in multiple ways. These partnerships should not be seen in isolation or as piecemeal, but as a network of actors that enable the implementation of a project, influence its success or failure, generate learning and allow its implementers to achieve goals that would have been beyond the scope of a single institution working in isolation. This network of partners usually involves actors working at different scales from the local to the global, and bringing in as well their own informal networks and contacts to support the established partnership. Thus universities, national and international research centres, local and international NGOs, community-based organizations, the private sector and international organizations can all cooperate within a project for the achievement of its final impact. They may play, however, very different roles determined by their diverse nature and capacity to influence the implementation process.

Conducting a network analysis of partnerships is crucial at both the project planning stage (*ex ante*) as well as after its implementation (*ex post*). During the former, it allows project implementers to identify and link with strategic partners that can enhance the chances of project success. During the latter, understanding the network's structure, depicting the degree of the actors' interaction, their roles in influencing and determining the final results, and assessing any transfer of influence from the project implementers to project beneficiaries are crucial exercises for determining the real impact of a project. Therefore such an analysis should be embedded in a project from its inception, including the required budget.

An excellent methodological tool for a network analysis of partnerships in the implementation of a project is Social Network Analysis (SNA), which constructs a 'map' of the linkages among different actors, their relationships and information flows between them using easy-to-understand and verify matrices and diagrams. Thus the focus of an SNA are the relationships and knowledge flows among interacting agents. Central issues include the interdependency of actors and the channelling of material and non-material resources between actors through relational ties or 'linkages.' The unit of analysis is therefore the relationship, not the organization itself.

In the context of the McKnight Foundation-funded project entitled *Assessing the Success of On-Farm Conservation Projects in Delivering Conservation and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools* coordinated and implemented by Bioversity International and carried out between March 2010 and May 2012 in the High Andes of Ecuador, Bolivia and Peru, we used SNA to examine six projects that supported on-farm management of native crop diversity and sought to increase livelihood benefits derived from it. This analysis was done only *ex post* since *ex ante* data and information were not available.

Network Structure

The measures of interest for the Andean study regard the concept of network centrality, which refers to the position of a network actor relative to other actors. Relationships between a pair of actors can be reciprocal (two-way) or univocal (only one-way). The analysis centres on relationships among different organizations and institutions and not among particular people. In this analysis there are three important parameters for network centrality: degree of centrality, closeness centrality and betweenness.

The study focused on the first two measures and did not apply the closeness measure because the researchers lacked sufficient information on the relationship between all the different pairs of actors in the network and only had access to information from the point of view of the implementing institution.

Degree of centrality of an actor is the number of other actors to which it is adjacent. It represents how much an actor is well-connected, how many 'choices' it has received and therefore how central it is in the network. It is a measure of local centrality because it ignores the indirect connections the actor may have.

Betweenness is the degree to which an actor is an intermediary between two other actors inside a group. It is a concept based on local dependency: an actor depends on another if the paths that connect it to other actors pass through this specific actor.

Closeness centrality represents the centrality of an actor as being as close to any other one in the graph. An actor is globally central if lies at short paths or distances from many other actors.

The relevant links in the network were defined according to four categories:

- *Money*: these include the links based on one actor providing financing to another, e.g. from the donor to the project-managing institution or from the latter to the institution that carries out activities in the field.
- *Research*: links based on one actor providing research activities to another, e.g. a university carrying out laboratory analysis for the implementing institution.
- *Training*: links based on capacity building activities, e.g. training in food preparation given by the implementing institution to a community.
- *Exchange of information*: this category includes all the links based on simple interaction between two actors who exchange relevant information related to the project or who participate in the same workshops, conferences, seminars.

To address the structure, links and influence of network actors, the study collected data from key informants of the implementing institution of each project and from the available project reports. In particular, to define the influence of an actor in the network the researchers asked the relevant key informants to gauge the intensity of the relationship with each actor involved in the network on a 1 to 4 scale. In this way it was possible to assess which actors have contributed more to the achievement of relevant project outputs and outcomes. It should be pointed out that ideally, data should be collected from every network member through participatory activities or through questionnaires, not just those in the implementing institution. However, due to timing and budgetary constraints this could not be done, so that the researchers had to rely only on two sources of data:

- *Secondary data from project reports*: These data allowed the researchers to map out all the actors involved in each project and their direct or indirect linkages to other actors in the network. From this analysis of secondary data, an overview of the relationships between different actors involved in each project and of the eventual interactions between different projects was developed.
- *A survey of key project informants*: The survey was submitted to project leaders in order to validate and complement the information from secondary data. Respondents were asked to add other missing actors relevant to the project. The survey asked whether the relationship between the implementing institution and the other actors was direct or indirect; what services were provided to and received from these institutions (money, research, training etc.); and the intensity of the relationship with each institution involved in the project.

The information obtained from key informants was cross-checked with secondary data from reports and updated in order to obtain a final matrix of actor-by-actor relationships that accounted for the direction, the type and the intensity of the relationships.

Network Analysis Results

From the network analysis, researchers gathered some interesting insights into the network characteristics and links involved in the six on farm conservation projects we analyzed (Table 1). Variation was noted in the network parameters among projects both in terms of *degree centrality* and *between centrality*, with half of them having high levels on both parameters, as is shown in the table.

The relationships between network partners (the ways in which they interacted and were linked) were based on differences and similarities in terms of *type, focus* and *scope.* The ***type*** of relationship was characterized as research, training or exchange of information. The most common type of link was "exchange of information", followed by training. Research links were only present in half of the projects.

In terms of **focus**, which to a large degree determined the strength of an institution within the network, some projects concentrated on research

activities with universities and private institutions, while others aimed at a rural development focus on training activities and dissemination of information. Not surprisingly, projects with a strong research focus included among their partners universities or national research institutes that were also linked to other similar types of organizations that network together.

Table 1: Key Parameters of Network Structures

Network structure	
Degree of centrality	**Number of projects**
Low	1
Medium	2
High	3
Between centrality	
Low	0
Medium	3
High	3
Type of predominant links (not mutually exclusive)	
Research	3
Training	4
Exchange of information	5
Influential actors	**Number of actors**
Mean	5.8
Minimum	4
Maximum	9
Total actors	
Mean	25
Minimum	15
Maximum	37

The **scope** of a project, particularly the levels (international, regional, national, local) on which it operated, was crucial in determining the number of influential actors and the total number of actors (see table above). There is wide variation in the number of partners in the network among projects, but only a fraction of them could be considered influential.

Public institutions involved in projects tend to attract other public institutions as their main partners. Half of the projects involved universities among their main partners: collaborations are strong especially in terms of academic research, student training and knowledge transfer. This kind of collaboration seems beneficial both in increasing collaboration seems beneficial both in increasing the research capability of implementing institutions and in providing opportunities for universities to gather data and training students as part of larger research or development projects. International organizations have a significant role in all the projects studied as they leverage resources, provide technical assistance, capacity building, and sometimes research activities. Finally, national institutes are present in all six projects, a fact which points to an interest in this kind of project at a public level. These institutions usually provide funding, but in some cases they also offer technical assistance and capacity building. It should be pointed out that the majority of institutions involved in the projects have livelihood improvement as their main goal.

CONCLUSION

This brief introduces the importance of analyzing and understanding the network of partnerships that underpins any on-farm conservation project and presents Social Network Analysis as a useful tool. As an illustration of how this methodology can be applied, the brief provides a summary of its use in the study of six on-farm conservation projects and the resulting variations found among them. However, due to data limitations, its use in the case study in-depth analysis of the contribution of partnerships to project success was limited, but should still motivate project designers and implementers to take a more systematic approach to planning, analyzing and understanding the network of partnerships in the projects they intend to implement (*ex ante*) or have implemented (*ex post*). For the former, network analysis serves for mapping out information flow, power structure and bottlenecks in a network and for understanding which actors can aid or impede the successful development of the project as well as the channels that would lead to greatest dissemination. For the latter, network analysis provides an understanding of the type and intensity of interactions created in a project, whether they were successful in linking relevant actors and in effecting dissemination and then relating these insights to the project outcome. Alternatively, network analysis could simply be used as a tool for *ex post* analysis or impact assessment. This is an area that merits further research and application.

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Análisis de Redes para Evaluar Proyectos de Conservación en Fincas

Hoja Divulgativa

Los proyectos de conservación en finca, así como la mayoría de los proyectos que utilizan la investigación para fomentar el desarrollo, suelen involucrar múltiples socios que juegan roles distintos, tienen diferentes perspectivas, e influyen sobre un proyecto de múltiples maneras. Las relaciones entre estos socios no deben ser consideradas en forma aislada o fragmentada, sino como una red de actores que permiten implementar e influir sobre el éxito o fracaso de un proyecto, contribuyen a generar aprendizaje y facilitan alcanzar metas que hubieran estado fuera del alcance de una sola institución trabajando de manera aislada.

Una red de socios involucra a varios actores trabajando a diferentes escalas, de lo local a lo global. Estos actores traen consigo sus propias redes informales y contactos que pueden asimismo apoal proyecto. Universidades, centros de investigación nacional e internacional, ONGs locales e internacionales, organizaciones de base comunitaria, el sector privado y organizaciones internacionales pueden cooperar en un proyecto para lograr su impacto final. Los roles que estos actores pueden jugar dependen de su propia naturaleza y su capacidad para influir en el proceso de implementación del proyecto.

Es fundamental analizar a los actores de la red asociada a un proyecto, tanto en la etapa de su planificación (*ex ante*), como después de su ejecución (*ex post*). En la primera etapa este análisis permite a los ejecutores del proyecto identificar y vincularse con socios estratégicos que puedan mejorar las probabilidades de éxito del proyecto. Despues de la ejecución del proyecto, permite comprender la estructura de la red, los grados de interacción entre actores, sus roles en la influencia y la determinación de los resultados finales, asi como evaluar si hubo una transferencia de influencia de los ejecutores del proyecto a los beneficiarios del mismo. Este análisis es crucial para determinar el impacto real del proyecto, por lo que debe ser considerado desde el inicio de un proyecto, incluyendo el presupuesto necesario.

Una excelente herramienta metodológica para analizar el papel de la red de socios en la implementación de un proyecto es el Análisis de Redes Sociales (ARS), el cual construye un mapa de vínculos entre los diferentes actores, sus relaciones y el flujo de información entre ellos de una manera fácil de comprender y verificar a través de matrices y diagramas. El enfoque del ARS es sobre las relaciones y flujos de información y conocimientos entre los actores involucrados en un proyecto. Los temas centrales incluyen la interdependencia entre actores a través un análisis de los vínculos que los relacionan. La unidad del análisis es la relación, no la organización en sí.

En el marco del proyecto, financiado por la Fundación McKnight, titulado *Evaluando el Éxito de los Proyectos sobre Conservación en Fincas en la Entrega de Resultados de Conservación y Medios de Vida: Identificando las Mejores Prácticas y Herramientas de Apoyo* coordinado por Bioversity International, y llevado a cabo entre marzo del 2010 y mayo del 2012 en los altos Andes de Ecuador, Bolivia y Perú, se utilizo el ARS para examinar seis proyectos que apoyaron el manejo de la diversidad de los cultivos nativos en finca con el objeto de incrementar los beneficios asociados con los medios de vida de agricultores que mantienen esta diversidad. Este análisis fue hecho sólo *ex post* ya que no hubo datos *ex antes* disponibles.

Estructura de la Red

Los indicadores de interés para este estudio se centran en el concepto de “centralidad de la red,” que se refiere a la posición de un actor en la red con respecto a los otros. Las relaciones entre un par de actores pueden ser recíprocas (bidireccional) o unívocas (sólo de ida). El presente análisis se centra en las relaciones entre las diferentes organizaciones e instituciones y no entre personas en particular. Hay tres parámetros importantes asociados al concepto de centralidad de la red: el grado de centralidad, la centralidad de cercanía, y la centralidad de intermediación.

El estudio se enfocó solo en dos de estos parámetros, ya que no aplicó la medida de centralidad de cercanía debido falta de suficiente información sobre la relación entre todos los actores de la red; sólo se tuvo acceso a información desde el punto de vista de la institución ejecutora.

Centralidad de Grado de un actor esta dado por el número de actores con los que se vincula. Es la representación cuantitativa de que tan buena es la conexión de un actor con otros. Cuántas conexiones ha tenido y por tanto su posición en la red. Mide solo la centralidad local ya que ignora las conexiones indirectas que el actor pueda tener.

Centralidad de Intermediación es el grado en que un actor es un intermediario entre otros dos actores dentro de un grupo. Este concepto se basa en la dependencia local: un actor depende de otro, si sus rutas de conexión con otros pasan a través de ese actor específico.

Centralidad de cercanía representa la posición del actor en términos de cercanía con otros. Un actor es central si se encuentra en rutas o a distancias cortas de muchos otros actores.

Los vínculos relevantes de la red se definieron de acuerdo a cuatro categorías:

- *Dinero*: son vínculos en que un actor financia a otro, por ejemplo, del donante a la institución ejecutora del proyecto o de ésta a una institución que gestiona las actividades de campo.
- *Investigación*: son vínculos en los que un actor provee actividades de investigación a otro, por ejemplo, una universidad que hace un análisis de laboratorio a la institución ejecutora del proyecto.
- *Capacitación*: son vínculos basados en actividades que crean capacidades, por ejemplo, una capacitación en preparación de alimentos dada por la institución ejecutora a una comunidad.
- *Intercambio de información*: esta categoría incluye todos los vínculos basados entre dos actores que intercambian información relevante relacionada al proyecto o que participan en talleres, conferencias, seminarios.

Para especificar la estructura, los vínculos y la influencia de los actores de la red, el estudio colectó datos de informantes claves en la institución ejecutora de cada proyecto, así como de reportes disponibles. En particular, para definir la influencia de un actor los investigadores solicitaron a los informantes clave relevantes medir la intensidad de la relación con cada actor involucrado en la red, en una escala de 1 a 4. De esta manera fue posible evaluar qué actores contribuyeron de mayor manera a la consecución de los productos y resultados del proyecto. Cabe señalar que de manera ideal los datos se deben recopilar de cada miembro de la red mediante métodos participativos o por medio de cuestionarios, y no sólo los de la institución ejecutora. Sin embargo, debido al tiempo y a limitaciones presupuestales esto no fue posible y los investigadores sólo dependieron de dos fuentes de datos:

- *Datos secundarios de reportes de los proyectos*: Estos datos permitieron a los investigadores hacer un mapa de todos los actores involucrados en cada proyecto y sus vínculos directos o indirectos con otros actores de la red. De este análisis emergió una visión de las relaciones entre los diferentes actores involucrados en cada proyecto y de posibles interacciones entre los diferentes proyectos.
- *Una encuesta a informantes clave del proyecto*: Se hizo una encuesta a líderes de los proyectos con el fin de validar la información de los datos secundarios. A los encuestados se les pidió adicionar otros actores relevantes que no hubieran sido identificados. En la encuesta se preguntó si la relación entre la institución ejecutora y los otros actores fue directa o indirecta; qué servicios fueron proporcionados y recibidos de estas instituciones (dinero, investigación, capacitación etc.); y la intensidad de la relación con cada institución involucrada en el proyecto.

La información obtenida de los informantes clave fue cotejada con los datos secundarios y reportes, actualizándose de ser necesario, con el fin de obtener una matriz final de relaciones actor-por-actor que representara la dirección, el tipo y la intensidad de las relaciones.

Resultados del Análisis de la Red

Del análisis de redes, los investigadores obtuvieron una mayor comprensión sobre las características de las redes y los enlaces involucrados en los proyectos estudiados (Cuadro 1). Se observo variación en los parámetros de *centralidad de grado* y *centralidad de intermediación* entre proyectos, encontrándose en la mitad de éstos, altos niveles en ambos parámetros, como se muestra en el cuadro.

El análisis de las relaciones entre los socios de las redes (la manera como interactuaron y como se vincularon) se hizo con base en sus diferencias y similitudes en términos de: *tipo, enfoque* y *alcance.* El ***tipo*** de relación fue caracterizado como: investigación, capacitación e intercambio de información. El tipo mas común de relación fue el

"intercambio de información", seguido por la capacitación. Los vínculos en investigación se dieron sólo en la mitad de los proyectos.

En términos de ***enfoque,*** dado en gran medida por la fortaleza de una institución dentro de la red, algunos proyectos se concentraron en actividades de investigación con universidades e instituciones privadas, mientras que otros dirigieron el enfoque al desarrollo rural con actividades de capacitación y de diseminación de información. Como era de esperar, proyectos con un fuerte enfoque en investigación incluyeron entre sus socios a universidades e institutos nacionales de investigación, que a su vez estaban vinculados también a otros tipos similares de organizaciones.

Tabla 1: Parámetros Clave en la Estructura de la Red

Estructura de la Red	
Centralidad de Grado	**Número de proyectos**
Bajo	1
Medio	2
Alto	3
Centralidad de Intermediación	
Bajo	0
Medio	3
Alto	3
Tipo de vínculos predominantes (no mutuamente excluyente)	
Investigación	3
Capacitación	4
Intercambio de Información	5
Influencia de actores	**Número de actores**
Significativo	5.8
Mínimo	4
Máximo	9
Total de actores	
Significativo	25
Mínimo	15
Máximo	37

El ***alcance*** de un proyecto, particularmente en los niveles a los cuales operaba (internacional, regional, nacional, local), fue crucial para determinar el número de actores por grado de influencia y el número total de actores involucrados (ver tabla anterior). Existe una amplia variación en el número de socios en la red entre los proyectos, pero sólo una fracción de ellos podría considerarse influyente.

Las instituciones públicas involucradas en los proyectos tienden a atraer a otras instituciones públicas como socios principales. La mitad de los proyectos involucraron a universidades como socios principales, llevando a cabo una fuerte colaboración en términos de investigación académica, formación de estudiantes y transferencia de conocimiento. Esta clase de colaboración muestra un beneficio mutuo, ya que aumenta la capacidad de investigación de la institución ejecutora y brinda oportunidades para que las universidades reúnan datos y capaciten estudiantes en el marco del proyecto. Las organizaciones internacionales tiene un rol significativo en todos los proyectos estudiados ya que ayudan a conseguir recursos, proveen asistencia técnica, contribuyen a la creación de capacidades, y en ocasiones, actividades de investigación. Finalmente, las instituciones nacionales están presentes en todos los proyectos, lo que apunta a un interés en esta clase de proyectos a nivel público. Estas instituciones usualmente proveen financiamiento, pero también en algunos casos ofrecen asistencia técnica y creación de capacidades. Cabe señalar que la mayoría de las instituciones involucradas en los proyectos tienen como objetivo principal el contribuir a mejorar los medios de vida de la población rural.

CONCLUSIÓN

Este informe muestra la importancia de analizar y entender la red de asociaciones que subyace en cualquier proyecto de conservación en finca y presenta al Análisis de Red Social como una herramienta útil para ello. Ilustra cómo esta metodología puede ser aplicada, provee un breve resumen de su uso en el estudio de seis proyectos de conservación en finca y algunos resultados relevantes. Sin embargo, debido a limitaciones en los datos, su aplicación a profundidad en el estudio de los seis proyectos presentado fue limitado. Sin embargo, que lo presentado motive a los diseñadores y ejecutores de proyectos de conservación en finca a adoptar un enfoque más sistemático en la planificación, análisis y comprensión de relaciones entre actores en los proyectos que intenten por implementar (*ex ante*) o que ya hayan (ex post). Para los primeros, el análisis de redes sirve para hacer un mapa del flujo de información, las estructuraras el poder y los cuellos de botella en la red y para entender qué actores pueden ayudar o impedir el desarrollo exitoso de un proyecto, así como los canales para maximizar la divulgación de sus resultados. Por último, el análisis

de redes proporciona una mayor comprensión del tipo e intensidad de las interacciones creadas en un proyecto, si los vínculos entre los actores relevantes fueron exitosos y hicieron de más efectiva la implementación del proyecto. En última instancia el análisis de la redes puede utilizarse simplemente como una herramienta *ex post* para la evaluación de impacto. Este es un tema que amerita mayor investigación y aplicación.

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Conserving landraces, Improving Livelihoods: A Framework for Assessing the Success of On-Farm Conservation Projects

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Conserving landraces, improving livelihoods: A framework for assessing the success of on-farm conservation projects. In the last 20 years there has been a growing interest in on-farm conservation of crop diversity, with numerous projects to support it being implemented worldwide. There is, however, very little systematic assessment of the extent to which this type of project is successful at contributing to the maintenance of crop diversity on-farm and the creation of associated benefits for farmers. The factors and interrelationships involved in on-farm conservation are complex, so that a conceptual scheme that brings them together in a simplified but coherent fashion can be extremely useful for scientists, donors, policy makers and practitioners to design on-farm projects and assess their success in a more systematic way. This paper presents a conceptual framework for analyzing and measuring the extent to which on-farm conservation projects contribute to delivering conservation and livelihood outcomes. A case study assessing an on-farm conservation project of native crops in the High Andes of Bolivia is used to illustrate how this framework can be made operational in concrete situations, as well as presenting some of the empirical and analytical limitations and challenges faced.

Conservando variedades nativas, mejorando medios de vida: Un marco para evaluar el éxito de proyectos de conservación en finca. En los últimos 20 años ha habido un creciente interés en la conservación de la diversidad de cultivos en finca, llevándose a cabo numerosos proyectos con este fin a nivel mundial. Sin embargo, no ha habido una evaluación sistemática de su éxito. Los factores y las interrelaciones implicados en la conservación en finca son complejos, por lo que un esquema que los conceptualice de una manera simple y coherente puede ser de gran valor para científicos, donantes, tomadores de decisiones y practicantes de este tipo de proyectos, con el objeto de mejorar su diseño y poder evaluar su éxito de manera más sistemática. Aquí se presenta un marco conceptual para analizar y medir el grado en que este tipo de proyectos contribuyen a dar resultados deseados en términos de conservación de cultivos en finca y de beneficios para los agricultores involucrados. Con el objeto de ilustrar como este marco se puede aplicar en una situación real, se presenta un caso de estudio de un proyecto de conservación de cultivos nativos en los Andes de Bolivia, y así mismo se discuten las limitaciones y los retos de poner dicho marco en práctica.

Keywords: crop diversity, evolutionary services, genetic resources, High Andes, Bolivia

Introduction

The diversity of crops cultivated by humans has been and continues to be a fundamental component of our food supply, necessary for good nutrition and essential to confront the future challenges of feeding nine billion people under the effects of climate change. Crop diversity at the phenotypic and genotypic levels provides humans with different and nutritious foods and other products and services, and in particular allows farmers and scientists to adapt crops and farming systems to heterogeneous and changing environments, a fact attested by the diffusion of a great number of crops from their centers of origin to completely new and different environments. The conservation of crop diversity has been a

worldwide concern for many decades, particularly due to the worry that a great amount of this diversity would disappear through genetic erosion with agricultural and economic development (Brush 2004; Gepts 2006). This concern has led to the collection and conservation of seeds and planting material in gene banks, i.e. *ex situ* conservation (Gepts 2006). While genetic erosion has occurred in certain crops and certain areas, still a large amount of crop diversity is present in developing countries and grown by smallholder farmers, particularly in centers of crop domestication and diversity (Brush 2004; Jarvis et al. 2008; Zimmerer 2010). The recognition of this "de-facto" conservation of crop diversity has led to a growing interest in on-farm conservation of landraces in centers of crop diversity (Bellon et al. 1997; Bretting and Duvick 1997; Brush 2004; Gepts 2006).

On-farm conservation refers to the maintenance of landraces in farmers' fields and orchards where they originated and aims at maintaining the processes of crop evolution (Brush 2004). These processes generate new potentially useful genetic variation that contributes to maintaining the capacity of agricultural and food systems to adapt to change, particularly if that change is unpredictable (Bellon 2009). The processes depend on the interaction between the genetic diversity of the relevant crop, the environments in which is grown and the farmers' preferences, incentives, knowledge, management practices, and social organization (Bellon et al. 1997). On-farm conservation then is about conserving socio-biological processes -- not particular landraces or varieties.

While "*de-facto*" conservation of diverse landraces on farm continues for many crops in their centers of diversity, allowing farmers to derive multiple benefits (Brush 2004, Jarvis et al. 2011), it also faces challenges. There are increasing incentives associated with new opportunities brought about by economic development and cultural change that encourage smallholder farmers to stop growing crop diversity on-farm (Bellon 2004; Zimmerer 2010).

Furthermore, it would be unfair to expect smallholder farmers, who tend to be poor, to maintain crop diversity for the long-term benefit of society at the expense of new opportunities that may enhance their personal or family wellbeing in the short term. Therefore, in many situations, outside interventions (projects) are needed to maintain the viability and fairness of on-farm conservation. In the last two decades there have been many projects worldwide to support on farm conservation implemented by many different types of institutions (national and international NGOs, farmers' organizations, universities, international research organizations) and supported mainly by foundations and international organizations. These projects have yielded important insights into the role of farmers in the process, their reasons for maintaining crop diversity on-farm and the threats they face. They have also piloted numerous interventions to support on-farm conservation. However, there has been very little systematic assessment of the extent to which these projects have actually produced on-farm conservation outcomes in terms of maintaining or increasing crop diversity on-farm (including farmers' knowledge and practices that underpin this diversity) as well as of livelihood outcomes that create benefits for farmers. The factors and interrelationships involved in on-farm conservation are complex, so that a conceptual scheme that brings them together in a simplified but coherent fashion can be extremely useful for scientists, donors, policy makers and practitioners involved in on-farm conservation projects to assess the success of their projects in a more systematic way.

This paper presents a framework for analyzing and measuring the extent to which interventions by projects aimed at supporting on-farm conservation deliver relevant conservation and livelihood outcomes. It illustrates how this framework can be made operational in concrete situations with a case study assessing an on-farm conservation project of native crops in the High Andes of Bolivia and presents some of the empirical and

analytical limitations and challenges faced. The paper is divided into four sections: a short overview of on farm conservation; a presentation of the framework; the case study; and a discussion of the framework followed by conclusions.

On-farm conservation strategies' contribution to sustainable agricultural systems

Crop diversity is unequally distributed around the world and is concentrated in centers of diversity, which often coincide with centers of crop domestication (Gepts 2006). In these locations, besides the presence of a large genetic diversity expressed in a multiplicity of phenotypes with different traits, there is a long history of co-evolution between humans and crops, as is reflected in agricultural systems characterized by: (i) the cultivation of a diverse set of landraces with an associated knowledge base; (ii) the existence of multiple uses and preparations, usually linked with particular cultural preferences; (iii) specific management practices such intercropping or rotations, as well as seed selection and sharing; (iv) matching specific landraces to particular environmental niches for optimizing production and managing risk; and (v) social norms and organization that underpin all of these aspects (Bellon 1996; Brush 2004; Perales et al. 2003; Zimmerer 2010).

The structure and dynamics of these landraces are the result of environmental and human selection pressures and depend crucially on farmers' seed systems (the interrelated set of actors, rules, interactions and infrastructure by which farmers obtain seed or planting material through time and space). Seed systems usually involve selecting, saving and sharing seed among farmers. This enables alleles and genotypes to pass from one generation to the next, contributing to shaping the traits that are under human selection. In addition, through the movement of the crop and determination of the location where it is planted, seed systems influence the specific biotic and abiotic selection pressures the crop is exposed to, such as

119 climatic conditions, specific soils, pests and diseases (Gepts 2006; Nagarajan and Smale
120 2007; Pautasso et al. 2012; vom Broke et al. 2003). The agricultural systems that underpin
121 on-farm conservation tend to be open and dynamic, as well as quite decentralized, since
122 farmers and communities make different and independent decisions in multiple locations,
123 environments and situations (Bellon 2009; Gepts 2006; Perales et al. 2003). These systems
124 allow continuous evolution, creating and re-creating the crop diversity that exists today.

125 *On farm conservation delivers evolutionary services*

126 The objective of on-farm conservation is to maintain crop evolution and thus ensure the
127 generation of new, potentially useful, genetic variation. The outcome of on-farm conservation
128 then can be conceptualized as an "evolutionary service" to agricultural and food systems.
129 This service, while implicit in the definitions and rationale for on-farm conservation, has not
130 been explicitly conceptualized as such. The idea of ecosystem services has gained recognition
131 and value as a way to conceptualize how nature contributes to human well-being (Millennium
132 Ecosystem Assessment 2005) with an emerging consensus about the functional relationship
133 that links biodiversity and ecosystem functioning and underlines the importance of
134 evolutionary processes for the ecosystem consequences of biodiversity loss (Cardinale et al.
135 2012). There is increasing recognition that crop diversity on-farm can deliver multiple
136 ecosystem services (Hajjar et al. 2008; Jackson et al. 2012), but it is only recently that the
137 idea of evolutionary services is beginning to be explicitly recognized as a category on its
138 own. Evolutionary services have been defined as "all of the uses or services to humans that
139 are produced from the evolutionary process" (Faith et al. 2010: 4), contributing to keeping
140 our options open to benefit from biodiversity in unanticipated ways. Since conditions and
141 environments change, and some of those that are rare today can become common tomorrow
142 and *vice versa* by maintaining crop evolution, on-farm conservation contributes to the

generation of a diversity of "winning" (adaptive) combinations of genes and traits that are constantly being updated in response to multiple and changing situations. This in turn ensures that farmers and society are able to cope with and adapt better to change (Bellon 2009). Crop evolution may be critical for adaptation to climate change among smallholder farmers who depend on landraces (Mercer and Perales 2010).

The evolutionary services delivered by on-farm conservation do not depend on just a few farmers managing diverse crop populations in one village or even a group of farmers in a few villages in a particular area, but are tied to broader social and ecological landscapes. These landscapes consist of many farmers and villages interlinked to various degrees through seed systems and distributed across different types of environments facing diverse selection pressures from environmental factors and human management and preferences. This leads to the generation of an array of a broad base of genetic variation in constant evolutionary flux.

The dynamic nature of on-farm conservation contrasts with *ex situ* conservation, where the aim is to maintain for a long period without change the genes and genotypes contained in seed samples or planting material representative of the diversity of a particular crop. These two strategies are aimed at conserving different things. On-farm conservation is about maintaining processes, while *ex situ* conservation is about maintaining specific results of those processes (specific genes and genotypes sampled at a particular point in time). Both types of conservation then can be treated as complementary (Brush 2004; Bretting and Duvick 1997).

The public and private benefits generated by on farm conservation

The socio-biological systems that maintain landraces in centers of crop diversity produce two distinct types of benefits: private and public (Smale and Bellon 1999). The private benefits

refer to those that accrue to and are captured directly by farmers who maintain these systems, such as the food and products they consume or sell (and associated income), the safety nets they gain and the cultural values they fulfill. Public benefits refer to benefits that accrue also to others in addition to the farmers themselves and that can occur at different scales, such as the pest control properties of planting varieties with different resistance genes by different farmers (occurring at the local or regional level, e.g. Rebaudo and Dangles 2011) or the new potentially useful genetic variation generated by the management of landraces (the evolutionary services described above) and that can be available through seeds locally, regionally or globally to other farmers for direct use for planting or by breeders for further crop improvement. An important problem is that public benefits tend to be diffuse and longer-term and hence are often ignored in individual decision-making, which focuses on private benefits that tend to be concrete and short-term. This, together with the fact that the resources are limited, often leads to a divergence of interests between individuals and society and thus to trade-offs between the generation of public and private benefits (Heal et al. 2004; Smale and Bellon 1999). This result is a "social dilemma," where the incentives are against crop diversity and its sustainable use and in favor of economic activities that erode them. For example, the conventional explanation for crop genetic erosion is that farmers increasingly specialize and replace their diverse set of landraces with a few scientifically-bred varieties that provide them with higher yields and more income. While farmers pursue their legitimate private interest (higher incomes), crop genetic diversity that may be central to ensuring their own and others' adaptation to changing conditions or to the needs of future generations (public benefits) may be lost. Farmers as individuals may tend to under-invest in the conservation of landraces and associated genetic diversity relative to what society at large would consider optimal (Heal et al. 2004; Smale and Bellon, 1999). Hence outside interventions that align individuals' and society's interests may be needed.

Challenges to on farm conservation

While many smallholder farmers still maintain crop diversity on-farm in centers of crop diversity, they face increasing challenges to do so. Besides the replacement of a diverse set of landraces by a few scientifically-bred varieties, other mechanisms that can lead to the loss of crop diversity in farming systems include the replacement of a native crop of great diversity with another crop of little local diversity (e.g. sorghum by maize in parts of Sub-Saharan Africa) and farmers abandoning agriculture altogether and shifting to other activities or to migration. The incentives that underpin these changes are usually related to: (i) new market opportunities and/or government support programs that foster specialization in few varieties or crops; (ii) higher opportunity costs for labor or land associated with the introduction of new crops, varieties, economic activities or migration; (iii) cultural change that diminishes the value of traditional crops and customs; and (iv) the erosion of local seed systems due to social change and migration and increased reliance on formal ones (Bellon 2004).

Many of these factors may enhance farmers' well-being; it would not be fair to ask farmers to forego these opportunities for the sake of maintaining crop diversity for future use. Therefore, in many situations, outside interventions (projects) may be needed to maintain the viability of on-farm conservation.

Projects to support on farm conservation

On-farm conservation projects usually implement a series of interventions, i.e. activities that provide farmers with innovations such as new technologies, development of novel capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity. Interventions can influence the demand for crop diversity by aiming at (a) increasing the value of crop diversity for farmers or (b)

214 decreasing the opportunity costs of maintaining diversity through decreasing the costs of
215 obtaining access to it (Bellon 2004). A recent and extensive review by Jarvis et al. (2011)
216 identified 59 different types of interventions for supporting on-farm conservation—which can
217 also be conceptualized as influencing either the demand or supply of crop diversity—
218 however there is still scant evidence that such interventions actually make any difference.

219

220 **A framework to assess on-farm conservation projects**

221 Any project aimed at the on-farm conservation of crop diversity intends to influence
222 outcomes in three areas: (1) the relevant crop diversity and associated practices maintained in
223 an agricultural system; (2) the private benefits that farmers and their households derive from
224 that agricultural system (referred as livelihood benefits, e.g. food security, nutrition, income,
225 safety net, cultural identity), and (3) the public benefits that society derives from the crop
226 diversity maintained in an agricultural system (referred as societal benefits, e.g. option values
227 derived from crop evolution). These three outcomes are the result of complex interactions
228 among different biological, biophysical and socioeconomic processes and are in themselves
229 multi-dimensional and can occur at different scales. They are interrelated and dynamic, but to
230 simplify their relationships, they can be represented in a relatively simple framework. Below
231 we describe such a framework for assessing the success of on-farm conservation projects,
232 illustrating it with a series of graphs.

233 Figure 1a maps the position of a farming community (a group of farming households linked
234 by a local seed system) with respect to the crop diversity it maintains and the private benefits
235 it derives (point A). Since agricultural systems are not static, the position of a community in
236 this graph changes, moving to the lower right of the graph under economic development,

assuming that livelihood benefits increase with increased specialization, but with a concomitant decrease in the level of crop diversity (point B). This could be seen as the conventional view of the relationship between crop diversity and agricultural change that assumes a trade-off between these two outcomes. It should be stressed that we are not assuming a causal relationship between these two outcomes, but just representing a trend that is commonly assumed. The actual causal relationship is complex and contextual.

Figure 1b presents a hypothetical relationship between a metric that summarizes the level of crop diversity present in a landscape and the public benefits that this diversity generates, such as the option values associated with maintaining crop evolutionary processes (evolutionary services). Obviously, this relationship is quite complex and we know very little about the actual functional form that may relate these two outcomes, but for argument's sake we assume a sigmoid shape. There may be no benefits relevant for humans below a minimum threshold of crop diversity. Once this threshold is passed then additional diversity contributes positively to the evolutionary services generated by crop diversity, but probably at a decreasing rate up to a point where no additional benefits are produced and a plateau is reached.

Assuming compatible scales in the crop diversity metric in both figures, Figure 1a can be flipped by 90 degrees to the left in order to align the crop diversity axis with Figure 1b, resulting in Figure 2 that connects the three outcomes relevant for on-farm conservation (note that private benefits increase from left to right, while public benefits increase from right to left). Then one can map the position of a community with respect to the private livelihood benefits that it derives from crop diversity and the public benefits it contributes to society by maintaining this diversity. Figure 2a maps the trade-off described above, where economic development leads to a decrease in crop diversity, which in turn leads to a major loss of the

public benefits associated with the evolutionary services generated by crop diversity. If maintaining or increasing the public benefits derived from crop diversity is socially desirable, then interventions that provide farmers with innovations such as new technologies, development of capacities and skills or new forms of organization aimed at changing the way farmers and communities access, manage, use, perceive, consume and/or market crop diversity could be implemented in order to decrease the slope of the trajectory of change (and hence introduce a shift upwards), thereby reducing the loss of public benefits associated with that biodiversity.

Figure 2b presents a series of scenarios to illustrate how these interventions could change these relationships (the letters with the superscript refer to the different scenarios and are used to identify changes in the points from the right part of the figure into the left one). Scenario 1 is the same as depicted in Figure 2a, i.e. the process of change with a negative trend without any interventions, i.e. the counterfactual to the interventions. Scenario 2 presents the situation where, while there is still a negative trend in the relationship between the crop diversity maintained by a household or a community, interventions are implemented to shift the trend upward, leading to a much reduced loss of crop diversity and hence of the associated public benefits compared to Scenario 1, particularly since the relationship between crop diversity and public benefits is non linear. This indicates that if there is a plateau in the functional link between crop diversity and the evolutionary services it provides, it is possible to reduce crop diversity at little or no cost in public benefits, and hence not all loss of crop diversity is necessarily socially unacceptable.

Scenario 3 presents a situation that many may consider ideal, where crop biodiversity is maintained at is original level, delivering all associated public benefits of crop diversity together with a major improvement in the private benefits captured by a community. Finally,

Scenario 4 presents a worst-case, showing a trend in which both crop diversity and associated public benefits and private benefits of a community are reduced. This case may correspond to changes in the economic and social environment that lead to the abandonment of crop diversity but without any associated private benefits to the communities. For example, the introduction of a new crop leading to the total abandonment of the traditional crop in the hope of increasing income, followed by a collapse in the price or market of the former due to competition, changes in consumer tastes, or failure to produce due to the appearance of a non-controllable pest or disease.

In the context of this simple schema, an on-farm conservation project can be seen as a set of interrelated interventions that provide innovations to farmers aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity. In a successful project, these innovations are adopted by farmers and in turn translate into private (livelihood) benefits for them and their households in terms of enhanced income, food consumption and security, productivity, stability, and/or reduced vulnerability. The new ways crop diversity is used and managed leads to its maintenance in the agricultural system, where it continues to yield public benefits (e.g. evolutionary services). If the private net benefits (private benefits derived from these innovations minus the costs of implementing them) are judged by farmers as desirable enough, this should lead them to continue to apply them beyond the lifetime of the project, ensuring the sustainability of the process. Thus this simple framework provides a conceptual basis for analyzing the generic structure of an on-farm conservation project and assessing its success and sustainability.

From this model it is clear that assessing the success of on-farm conservation project requires answering four questions:

1) Do farmers apply the innovations provided by project interventions?

2) If so, does the application of these innovations lead to farmers maintaining levels of crop diversity higher than would have been possible without them?

3) Does this higher level of crop diversity lead to increased well-being among the households of farmers who applied the innovations?

4) Does the level of crop diversity associated with the application of innovations deliver additional evolutionary services that would not have occurred otherwise?

Answering positively to these questions will indicate that a project was successful. This implies that farmers who apply the innovations provided by project interventions: (a) maintain higher levels of crop diversity compared to those who do not apply them, and (b) that those farmers who maintain higher levels of crop diversity obtain additional benefits from this diversity compared to those with lower diversity. These implications can be tested empirically. This requires, on the one hand, clear and measurable indicators of adoption, significant levels of diversity and relevant well-being, and, on the other, a proper set of comparisons. Answering the first three questions is quite straight-forward, although it requires the appropriate methods and design. However, as indicated earlier, the answer to question 4 is still quite difficult since the functional relationship between levels of crop diversity and the generation of evolutionary services is little understood, although a simple principle may be that under uncertainty "more is better than less." Then by placing on-farm conservation projects in known areas with high levels of crop diversity, we insure that public benefits are delivered.

An example from Bolivia: on-farm conservation of quinoa and cañahua

To illustrate how the framework can be made operational in concrete situations, we use observational data from an on-farm conservation project on Andean grains in Bolivia that

was part of a larger study on assessing the success of on-farm conservation of native crops in the region. This example also shows some of the empirical and analytical limitations and challenges faced. The project "Enhancing the Contribution of Neglected and Underutilized Crops to Food Security and to Incomes of the Rural Poor" was implemented by the Fundación PROINPA and Bioversity International between 2007 and 2010 with the support of the International Fund for Agricultural Development. It was implemented in communities around Lake Titicaca with smallholder farmers and focused on quinoa (*Chenopodium quinoa* Willd.) and cañahua (*Chenopodium pallidicaule* (Aellen), although farmers maintained many other native and non-native crops as well. The project put into operation 16 interventions that provided different types of innovations to these farmers (Table 1). The high Andes are an important center of domestication and diversity for several crops (Castillo 1995), including quinoa and cañahua (Castillo 1995; del Castillo et al. 2007; Rojas et al. 2010; Vargas et al. 2010). These two Andean grains have a long history of cultivation and use by smallholder farmers in the region. They are highly nutritious and hardy crops well adapted to the harsh conditions of the high Andes (Rojas et al. 2010; Vargas et al. 2010). The region around Lake Titicaca shows high levels of genetic diversity and large assortment of phenotypes for both crops (del Castillo et al. 2007; Rojas et al. 2010; Vargas et al. 2010).

For the assessment of this project, we used both qualitative and quantitative methods, based on interactions with scientists, farmers and other stakeholders. Based on the framework and the results of the qualitative research, a survey was designed and carried out with a random sample of 162 farming households in two communities where the project was implemented. A questionnaire elicited information on indicators of project participation and application of the innovations provided by project interventions (adoption), relevant crop diversity and associated management, benefits associated with household wellbeing and socioeconomic

variables. The sample was drawn randomly from two populations -- those who participated in the projects (drawn from project records) and those who did not participate (drawn from the community at large), resulting in a stratified random sample based on participation, with the non-participants serving as "controls." We are keenly aware that this approach has limitations, such as a potential lack of comparability between participants and non-participants and hence biases in the results; however, in all project studied, interventions were not assigned randomly between treatment and control groups, there were no *a priori* control groups and neither baseline nor end-line data available, which hampered the use of alternative comparative approaches. The questionnaire included information on several socioeconomic, locational and environmental confounding factors (factors that are independent of project interventions that can either mask or exaggerate project impacts). The results presented here for illustration are limited to correlations among relevant indicators; a more sophisticated econometric analysis that corrects for potential biases and confounding factors is beyond the scope of this study, but is the subject of a future publication.

The following indicators were used to make the framework operational. Since project interventions were many and comprise multiple aims, the simplest indicator was the number of innovations provided by interventions applied (adopted) by a household. This indicator also takes into account the potential indirect effects due to spillovers (as will be shown, participation and adoption were greater than expected from records of participation). The indicator for crop diversity was derived from the number of crop populations recognized by local farmers as distinct units (farmer varieties) of both quinoa and cañahua, a measure of richness. A factor analysis was performed on the number of varieties of each target crop per household in order to obtain a reliable univariate measure of crop diversity; the result, the predicted factor, was used as the indicator. Factor analysis is a statistical variable-reduction

technique that captures most of the available information contained in multiple variables as a linear combination of them. As indicators of benefits associated with household well-being, the total quantity of quinoa and cañahua consumed and the gross revenues from their sale from household production were used. The public benefits associated with crop diversity were taken into consideration by the location of the projects. Figure 3 shows how these indicators relate to the framework.

Table 2 presents information on the indicators of participation and adoption (Panel A), crop biodiversity (Panel B) and livelihood benefits (Panel C). Panel A shows that actual percentage of participation was much higher than expected from the *a priori* information used to draw the sample of participants from project records (*ex ante* participants). The reason was that most interventions were open to everyone who wanted to participate and records of this type of participation were not kept. Results show that not all ex ante participants applied the innovations provided by project interventions, but most did. Furthermore, results also show that there is an important demand for these types of innovations among the overall population since many non-*ex ante* participants participated and applied them. On average, participants were involved in a high number of interventions and adopters applied many of the associated innovations, which were rated at least as "useful" by 50 percent of the adopting households. Panel B shows that in spite of relatively small landholdings, these households cultivate on average almost four crops. Two-thirds plant quinoa, most of them planting more than one variety, as well as saving seed and keeping a seed lot for a very large period. Cañahua is planted by a lower percentage of households, but still by slightly more than half, also maintaining on average more than one variety and relying on themselves for seed, while keeping a seed lot for a very long period. The rest of the seed is mostly sourced from other farmers, usually family and friends -- the

405 classical traditional seed system. Panel C shows that almost three quarters of the households
406 consumed the quinoa they produced, with a substantially lower proportion selling it. The
407 situation is different for cañahua; only half consumed it, but a larger proportion sold it and
408 the total quantity produced for both aims on average was almost double that of quinoa. For
409 those who sold them, the gross income obtained by households was substantially higher from
410 cañahua than from quinoa.

411 Table 3 shows the correlations among these indicators, which in all cases are positive and
412 highly statistically significant, indicating that participation is associated with higher adoption,
413 which in turn is associated with higher crop diversity. The latter is associated both with
414 higher amounts of quinoa and cañahua consumed by the household and higher gross
415 monetary income derived from their sale. While evidently a correlation is not causation and,
416 as indicated earlier, there may be other variables not related to any project intervention that
417 may influence these relationships, the evidence nonetheless is strongly suggestive that such
418 relations exist, and hence the answers to the first three questions posed by the framework
419 could tentatively be answered positively. A more rigorous testing of these relationships
420 requires more advanced econometric techniques and ideally a better project design that
421 includes from the outset a baseline and controls, but the case study presented clearly
422 illustrates the conceptual value and operational viability of the framework proposed here.

423 **Discussion and Conclusions**

424 The processes and outcomes associated with on-farm conservation of landraces in centers of
425 crop diversity are complex; causality is neither clear nor obvious. The framework presented
426 here clearly is a major simplification of these issues and their relationships, yet is
427 nevertheless valuable because it provides a scheme that allows us to reflect systematically on
428 these issues, organize our knowledge and identify knowledge gaps and lack of understanding.

It also makes operational concepts empirical in specific situations, leading to testing hypotheses and learning, as the case study has shown. Evidently it has limitations and there are many unresolved issues. Probably the most important one is the functional relationship between the amounts of crop diversity present in an agricultural system and the evolutionary services it generates, which is unknown. This relationship is likely scale-dependent, with the processes that underpin it and the benefits generated varying across different scales from the landrace to the field, the farm, the community, the landscape, the region and the world. Linkages across scales may be crucial for understanding it. Furthermore, the metrics for crop infraspecific diversity, both at the phenotypic and genotypic level can be quite complex, with measures varying depending on the traits measured and the scale at which measurement is performed (van Heerwaarden et al. 2009). These aspects require further research and the framework has been useful in identifying this knowledge gap.

The indicators used here are not the only ones possible. There may be many others, depending on the specific projects -- for example, using food security, life satisfaction or empowerment indicators for the livelihoods benefits. Crop diversity indicators could include more information on seed systems, seed selection practices, environmental adaptation, and local knowledge, or on phenotypic traits and genetic markers as well as on their structure. Participation and adoption indicators can be disaggregated by type of project intervention or by how complementary they are and could include indicators on social network processes.

The framework highlights that on-farm conservation projects by implementing interventions that link the conservation of crop diversity with improved smallholder farmers' well-being, not only create incentives for them to continue to maintain this diversity and generate evolutionary services, but also contribute to make the conservation process fairer to these farmers by aligning their short-term private interests with society's long-term public ones.

This in turn counters the common criticism that on-farm conservation keeps farmers poor and burdens them with maintaining public benefits at the expense of their private interests.

On-farm conservation as a provider of evolutionary services directly to farmers contributes to their endogenous capacity to respond to change while maintaining the structure and functioning of their agricultural systems, hence their resilience. Abandoning on-farm conservation processes may then make these systems much more vulnerable. The implementation of successful projects supporting on-farm conservation should enable farmers and their agricultural systems to remain sustainable and resilient by providing them with tools that enhance their capacity to face change under conditions of uncertainty.

The framework presented here provides a conceptual tool that allows scientists, donors, policy makers and practitioners involved in on-farm conservation projects to assess the success of their projects and to reflect systematically on the lessons learned. It is hoped that this should help them design and implement better projects that maintain crop diversity more effectively and deliver higher levels of well-being to the farmers who maintain it. The challenge of any on-farm conservation project then is to identify, design and implement interventions that make the conservation of crop diversity on-farm compatible with improved livelihoods and wellbeing among the farmers who conserve it.

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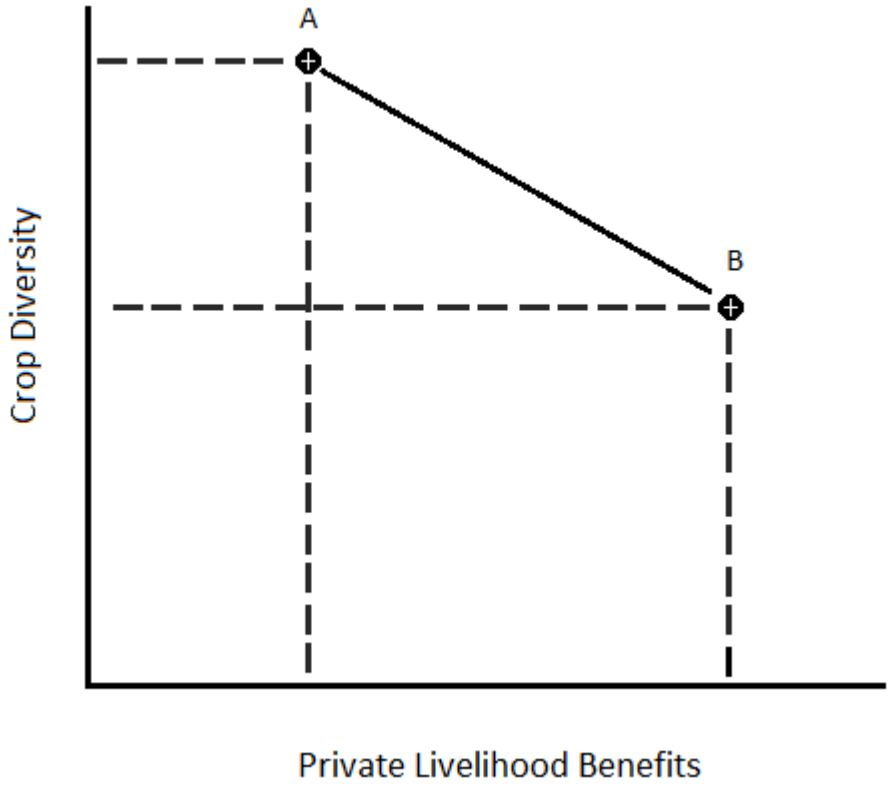

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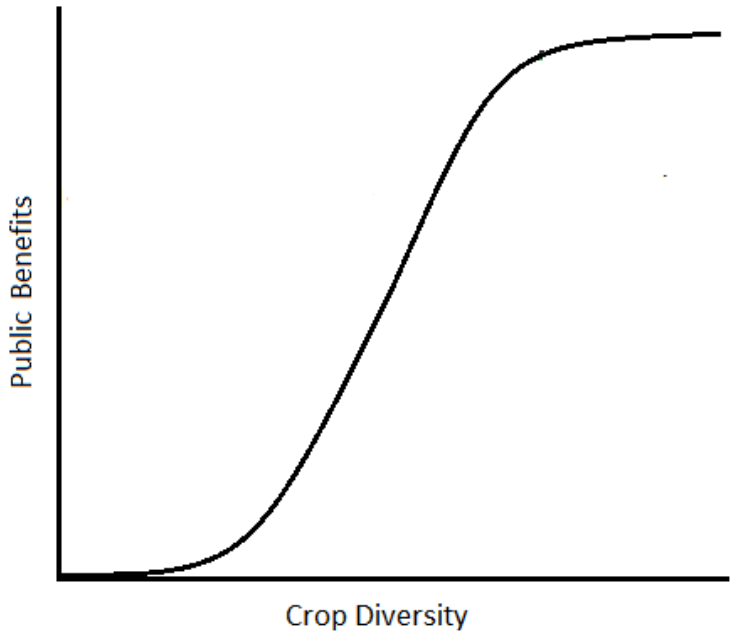

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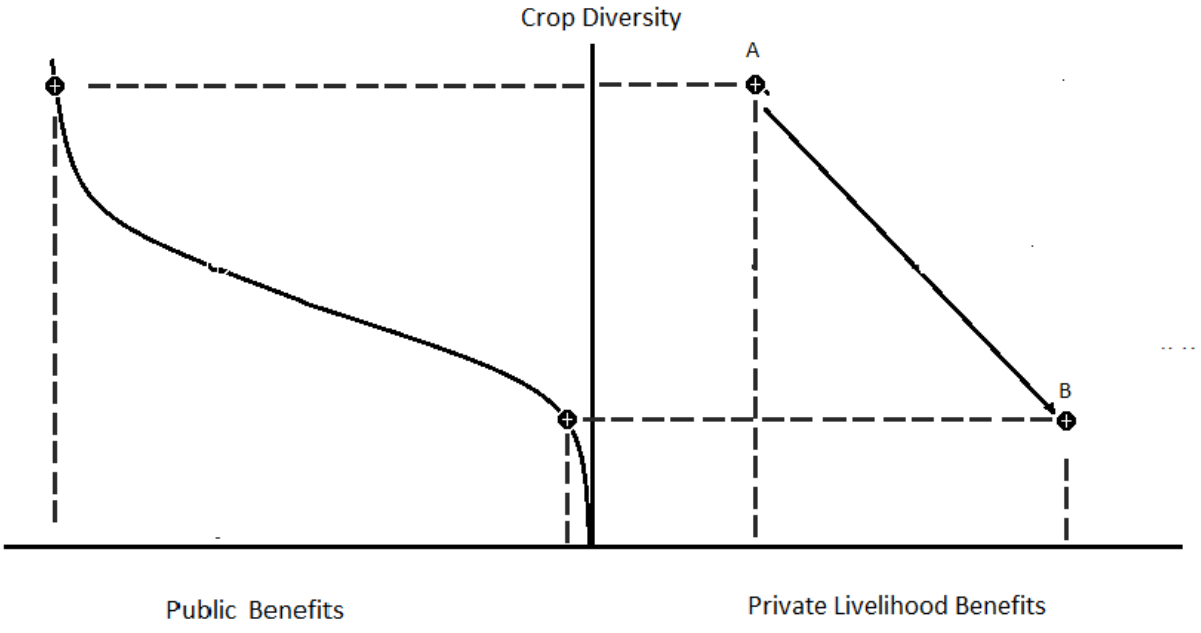
546 Figure 1b



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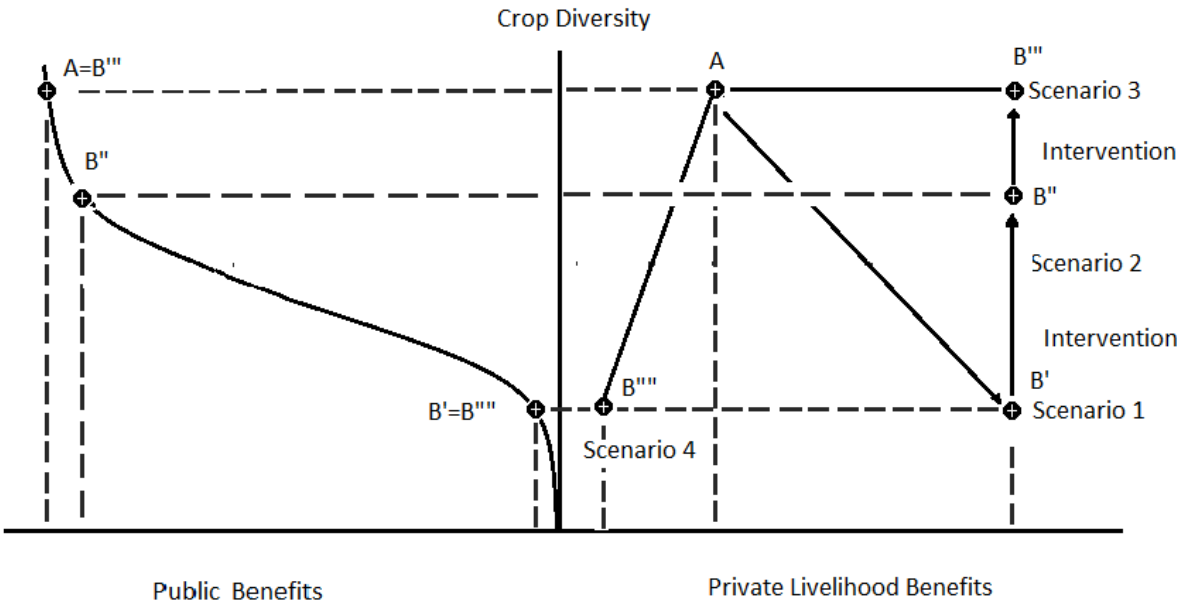

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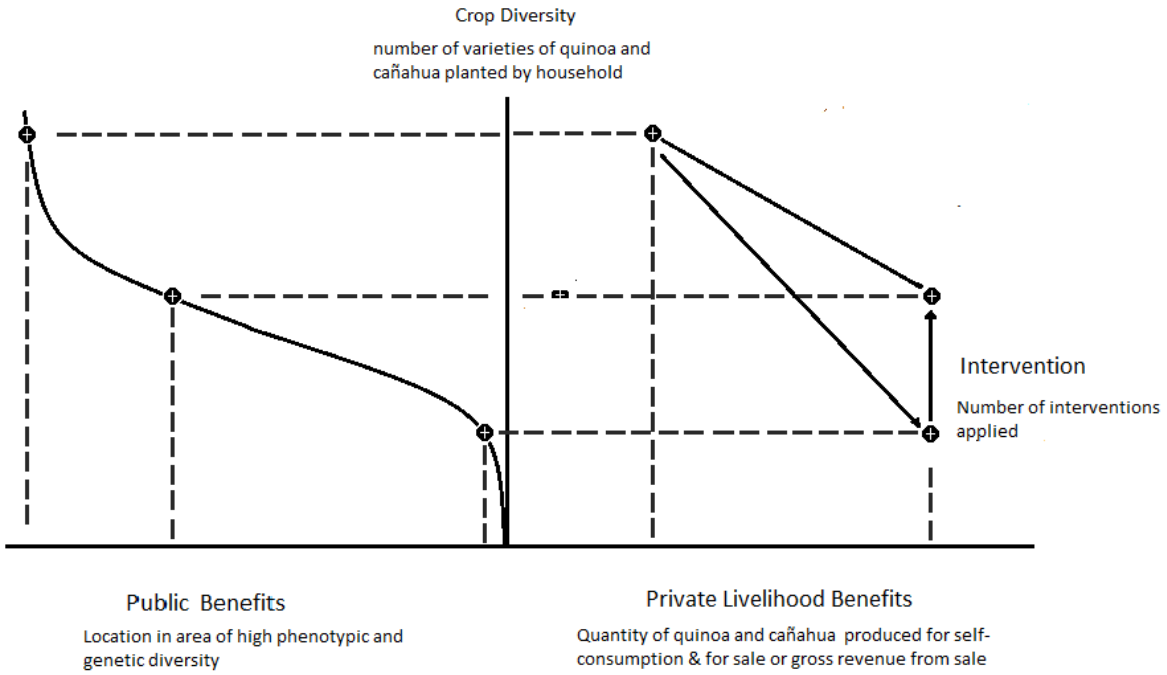
550 Figure 2b



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552 Figure 3

553 **Table 1: Interventions of the PROINPA-Bioversity International project on on-farm conservation of quinoa and cañahua**

Intervention	Innovation provided
Collection of local varieties of native Andean crops for PROINPA inventory	New knowledge about infraspecific diversity and its distribution, basis for broaden access to this diversity and to change perception about its value
Identification and description of Andean crops in the community	Broaden farmers' knowledge of the diversity available beyond the household and social network, contribute to change perception about its value
Introduction or planting of new varieties of quinoa or cañahua by PROINPA in the community	Access to farmers to additional diversity of target crops
Observation and evaluation of traits of new quinoa or cañahua varieties by PROINPA	New systematic and comparative knowledge allowing farmers better evaluation and choices
Training on crop management of quinoa and cañahua	New knowledge and practices to improve crop management
Training on potato harvesting	New knowledge and practices to improve potato harvesting
Training on pest control for quinoa and cañahua	New knowledge and practices for pest control
Training on prevention of weevil attack	New knowledge and practices for pest control
Agro-biodiversity competition	New knowledge about diversity held beyond the household and community, change of perception of its value

Training on new recipes and preparations with quinoa and cañahua	New knowledge and skills for novel ways of preparing food from traditional crops
Organizing a producer association of Andean crops or for tourism	New forms of organization to link to new business opportunities
Sale of quinoa in association with other farmers	New forms of organization to link to new business opportunities
Sale of cahañua in association with other farmers	New forms of organization to link to new business opportunities
Agro-touris: receive tourist at home or in field	New forms of organization to link to new business opportunities
Agro-tourism: other income from tourism	New forms of organization to link to new business opportunities
Agro-tourism: establishment of community museum	New forms of organization to link to new business opportunities

554 **Table 2: Indicators**

Panel A. Participation and adoption	
Sample size	162
Ex-ante rate of participation (%)	34.6
Observed Rate of participation (%)	53.1
Mean number of interventions participated	8
Adoption by *ex ante* participants relative to overall sample (%)	27.2
Adoption by *ex ante* participants relative to themselves (%)	78.6
Adoption by non *ex ante* participants relative to overall sample (%)	25.9
Adoption by non *ex ante* participants relative to themselves (%)	39.6
Mean number of interventions adopted	4
Median rating of usefulness of intervention	4
Panel B. Crop diversity	
Mean number of crops/hh	3.8
Quinoa *(Chenopodium quinoa*)	
Farmers planting (%)	76.5
Mean number of varieties/hh*	1.8
Seed sources (% farmers)	
own	87.3
years of replanting own seed	32.3
Cañahua (*Chenopodium pallidicaule*)	
Farmers planting (%)	51.9
Mean number of varieties/hh*	1.7
Seed sources (% farmers)	

own	85.7
years of replanting own seed	34.9

Panel C. Livelihood benefits*	Mean
Farmers consuming their own quinoa production (%)	74.1
Farmers selling quinoa (%)	15.4
Quantity of cañahua produced for self-consumption and sale (kg/hh)	71.1
Farmers consuming their own cañahua production (%)	51.2
Farmers selling cañahua (%)	27.2
Quantity of quinoa produced for self-consumption and sale (kg/hh)	43.1
Total quantity of both crops produced for self-consumption and sale (kg/hh)	83.9
Gross income from quinoa sold (Bolivianos/hh)	207.7
Gross income from cañahua sold (Bolivianos/hh)	425.1
Total gross income from both crops sold (Bolivianos/hh)	487.7

** only for those households producing the relevant crop*

555

556

Table 3: Correlations among indicators of on-farm conservation project success in Bolivia

	Adoption	Native Crop Diversity	Household Benefits	
			Qty quinoa & cañahua consumption & sale	Gross revenues from sale of quinoa & cañahua
Ex ante participation[1]	**0.42****			
Adoption		**0.51****		
Native Crop Diversity			**0.38****	**0.45****

Note: *, **, ***, ****, significant at the .10, .05, .01, .001 level respectively

[1] Since participation is a binary variable, the coefficient reported here is derived from a Point-biserial correlation. The rest are Pearson correlations.

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Assessing the Contribution of On-Farm Conservation Projects of Crop Biodiversity to Resilient Agricultural and Food Systems. Evidence from the High Andes of South America.

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Introduction

Crop genetic diversity is unequally distributed around the world and is concentrated in centers of diversity which often coincide with centers of crop domestication (Gepts 2006), where many smallholder farmers continue to maintain it (Brush 2004; Jarvis 2008). This diversity is the result of the interaction between farmers and the crops they grow in the agricultural systems they manage, constituting socio-biological systems that maintain crop evolution in distinct environments, subject to multiple selection pressures due to human preferences and different and varying biotic and abiotic factors (Bellon 2009; Gepts 2006; Brush 2004; Vigouroux et al. 2011). Conserving these socio-biological systems—also known as on-farm conservation—contributes to retaining potentially useful but undetermined genetic variation and to generating novel ones needed to maintain the capacity of agricultural and food systems to adapt to change. On-farm conservation can be conceptualized then as delivering an evolutionary service (Faith et al. 2010) to agricultural and food systems. It is because we have had these processes in the past that we currently have the genetic variation that allows farmers and plant breeders to adapt to heterogeneous and changing conditions. Therefore the need for and value of maintaining crop evolution on farm today is to enable society to continue to have the broad genetic variation needed to adapt to change tomorrow, particularly if uncertain. Thus supporting on-farm conservation is important in the pursuit of globally resilient agricultural and food systems.

These socio-biological systems depend crucially on farmers' preferences, incentives, knowledge, management practices, institutions and social organization (Bellon 1997, Brush 2004; Zimmerer 2010). While farmers in centers of crop diversity continue to maintain crop diversity and evolution without any outside intervention —known as *de facto* conservation—there is no assurance that this may continue in the future. Maintaining crop diversity on-farm can entail important costs to smallholder farmers, and increasingly there are incentives associated with new opportunities brought about by economic development and cultural change that encourage them to abandon this diversity (Bellon 2004; Zimmerer 2010). Furthermore, we cannot expect these farmers, who tend to be poor, to maintain crop diversity for the long-term benefit of society at the expense of their short-term personal or family wellbeing. For these reasons there is a need for interventions to support farmers in maintaining the diversity. In the last 20 years many projects to support on farm conservation have been implemented worldwide. There has been very little systematic assessment, however, of the extent to which these projects have actually made a difference beyond what *de facto* conservation is already delivering. For example, a recent and extensive review (Jarvis et al.

2011) identified 59 different types of interventions for supporting on-farm conservation worldwide, but there is little evidence that they actually made a difference. Projects supporting on-farm conservation can contribute to the resilience of agricultural and food systems only if they actually make a difference beyond what farmers do on their own, hence there is a need to systematically assess their contribution.

The factors and processes involved in on-farm conservation of crop diversity are complex (Bellon et al. 2012). On-farm conservation projects usually implement a series of interventions (i.e. activities that provide farmers with innovations such as new knowledge, technologies, development of novel capacities and skills or new forms of organization aimed at changing the way they access, manage, use, perceive, consume and/or market crop diversity) and in doing so should create incentives for farmers to continue to maintain this diversity. Many of these interventions are based on farmers' local knowledge, practices or institutions, but usually with new twists. In a successful project then, farmers apply the innovations provided by project interventions, which in turn should translate into private benefits for them and their households in terms of enhanced income, food consumption and security, productivity, stability, and/or reduced vulnerability. The new ways crop diversity is used and managed should lead to its maintenance in the agricultural system, which in turn should continue to yield public benefits, such as evolutionary and other ecosystem services. If project-introduced innovations are incorporated into farmers' livelihood strategies, then the process becomes sustainable beyond the life of the project. This apparently simple chain of events, however, masks great complexity, since each of the decisions and processes involve the interaction of multiple factors at different scales and some are still poorly understood. While this chain of events may seem too simplistic and linear, a linear approximation is useful for dealing with complex processes in terms of understanding and assessing particular aspects of the issues involved and can also be useful by providing clear and testable hypotheses about observable outcomes. Therefore assessing empirically the success of an on-farm conservation project requires testing four different but related hypotheses: (1) participation in project interventions leads to the application of the innovations provided by the interventions; (2) the application of these innovations lead to farmers maintaining higher levels of crop diversity than would have been possible without them; (3) farmers who maintain these higher levels of crop diversity obtain additional benefits from this diversity; (4) the higher levels of crop diversity associated with with the application of these innovations deliver additional evolutionary services that would not have occurred otherwise. Testing the first three hypotheses is empirically possible, under certain conditions generally encountered in social policy studies. The fourth, however, remains a major challenge since the functional relationship between levels of crop diversity and the generation of evolutionary services is little understood to date.

This paper analyzes the success of five on-farm conservation projects for six native crops in the High Andes by testing the first three hypotheses identified above. The crops involved are quinoa (*Chenopodium quinoa* Willd.), cañahua (*Chenopodium pallidicaule* (Allen)) potatoes (*Solanum tuberosum* Linn.), oca (*Oxalis tuberose* Mol.), ulluco *(Ullucus tuberosus* Caldas), and maswa (*Tropaeolum tuberosum* R.&P.). This region is an important center of domestication and diversity for these crops (Harlan 1992; Castillo 1995). Smallholder farmers there continue to be important custodians of the phenotypic and genotypic diversity of these crops (Castillo 1995; Zimmerer 1997). Many on-farm conservation projects have been implemented in the region by a variety of institutions from NGOs to universities and national research organizations and are supported by

different donors from national government to, foundations and international agencies. The five projects analyzed here were implemented in Ecuador, Peru and Bolivia and present a range of implementing agencies, donors, partners and combinations of native crops (Table S1), providing a broad perspective on on-farm conservation efforts.

Methods

Through an extensive review of the literature, including Internet searches, 26 projects focused on on-farm conservation of native crops in the High Andes of Ecuador, Peru and Bolivia were identified (Table S2). From those, five projects were selected for in-depth analysis representing different crops, types of implementing institutions, partnerships and donors. Project implementers were contacted and interviewed about project execution and information on project implementation, interventions applied and partnerships involved were obtained. A household survey was implemented in communities where projects took place. In each community, a stratified random sample was drawn based on participation: one strata being drawn from participants according to project records (referred as *ex ante* participants) and the other from the community at large, specifically those who had not explicitly participated in the project, to serve as control (referred to as non-participants). Unfortunately, no project had *a priori* control groups and neither baseline nor end-line data available, which hampered the use of alternative comparative approaches. A total of 748 households were interviewed. The survey elicited information on project participation, application of the innovations provided by the project, ratings on their usefulness and crops grown. In addition, for each one the researchers noted the number of farmer varieties that were sown and seed sources, objectives of production for each crop, quantity produced in the previous growing season, quantities consumed and sold, as well as price received (if available); and standard socioeconomic information on family demographics, education, landholdings, sources of income, migration, participation in local organizations and government programs.

Testing the three hypotheses associated with project success is complex because they are nested, and, in the context of this study, the relevant comparisons or counterfactuals have to be derived from data with a high likelihood of selection bias Since the assignment of households to the treatment and control groups is not random, several confounding factors that could influence the results and that if ignored could mask or exaggerate them. To address these issues, we adopted a standard econometric approach of non-experimental program evaluation studies (Heckman and Vytlacil, 2005): A simultaneous estimation of a linear system of three equations was performed via three-stage least squares (Zellner and Theil, 1962), each one corresponding to one of the hypotheses identified above. The model allows us to test simultaneously the three hypotheses involving a chain of hierarchical /causal relationships, and to control for reverse causality and other possible sources of endogeneity (Heckman and Vytlacil, 2005) with the support of appropriate instrumental variables. The stochastic version of the model is formulated in the following way:

$$\begin{aligned} \textit{Household Benefits}_i &= \mathbf{x}_i'\boldsymbol{\omega} + \delta\, \textit{Crop Diversity}_i + e_i \\ \textit{Crop Diversity}_i &= \mathbf{x}_i'\boldsymbol{\lambda} + \beta\, \textit{Adoption}_i + u_i \\ \textit{Adoption}_i &= \mathbf{x}_i'\boldsymbol{\vartheta} + \gamma\, \textit{Participation}_i + v_i. \end{aligned} \qquad [1]$$

Where $\mathbf{x}_i$ is a vector of other determinants of participation and outcomes of interest for the household *i*, such as several socio-economic characteristics of the sample, the environment, and the location of households; $\boldsymbol{\omega}$, $\boldsymbol{\lambda}$ and $\boldsymbol{\vartheta}$ are the parameter vectors of the equations' system, measuring the effects of the exogenous variables on our considered outcomes, respectively *Household Benefits*, *Crop Diversity* and *Adoption* of practices, while e_i, u_i and v_i are the error components.

The model measures through the estimation of the parameter γ whether the household was drawn from the sample of ex ante participants (Participation == 1) or from the one of non participants (Participation == 0) and the consequent effects on the application of innovations. Parameter β provides quantitative estimate of the impact of project interventions on crop diversity, while parameter δ accounts for the additional benefits obtained by a household from this diversity. Within this specification, we are implicitly assuming that ex-ante participation may influence crop diversity only through the application of innovation. Moreover, the application of innovation may influence additional benefits obtain by a household only through the use of crop diversity.

The variable used as indicator of the application of innovations was the number of innovations applied by a household. The indicator of crop diversity was the result of a factor analysis performed on the number of farmer varieties of all target crops planted by a household. The indicator for the benefits to a household was the quantity of produced target crops consumed and marketed. In one project, however, the indicator was a life satisfaction index derived from a series of ratings on the level of satisfaction experience by the household with respect to different variables such as housing, access to education, economic activities, social life and contacts, as well as nutrition and food security. The data from the two projects from Bolivia were merged to increase the sample size and statistical power given that both projects were implemented by the same institution in the same general geographic area and involved almost the same interventions.

Results

Households in projects' sites have very small landholdings, are typically composed of speakers of indigenous languages, either Quechua or Aymara, and are headed mostly by middle-aged men with low levels of formal education, low levels of migration and few sources of income outside their own agriculture. When there are other sources of income, they are frequently non-farm labor and very few households receive remittances (Table S3). The households, however, maintain an important amount of crop diversity in spite of the small landholdings (Table 1), both in terms of crop species and farmer varieties (i.e. crop populations within a crop that farmers recognize as distinct units). Households tend to grow many more species than those targeted by the studied on-farm conservation projects. A special case is a project implemented in Ecuador by a farmer organization that shows by far the highest level of infra and inter-specific crop diversity. The data show relatively poor marginal households maintaining important amounts of native crop diversity in a center of origin and diversity for these crops.

The on-farm conservation projects that were subjects of the study implemented between 13 and 19 interventions per project, for a total of 79, with different aims that included: (a) improving the knowledge and enhancing access of farmers to information and planting material of a diversity of targeted native crops; (b) improving the agronomic management of the crops, particularly in terms of pests and diseases; (c) training local farmers to provide advice to others; (d) improving the

consumption of these crops, their storage and processing; (e) improving their marketing to enhance income opportunities; (f) providing training and capacity building on these aspects; (g) enhancing farmer organization for consumption and marketing; (h) disseminating the associated information and knowledge; and (i) providing opportunities for income generation through agro-tourism. Each project presented households with different combination of these interventions, which in general provided project participants with a basket of options to choose from to fit their needs and contexts.

Results show that that the actual percentage of participation was much higher than expected from the *a priori* information used to draw the sample of participants from project records (ex ante participants) (Table 2). The reason was that most interventions were open to everyone who wanted to participate and records of this type of participation were not kept. The percentage of farmers who applied innovations provided by project interventions (adopters) was extremely high in all projects, and in one project the percentage was even greater than the number of total participants, suggesting an important diffusion of innovations to non participants. The high levels of participation and of application of innovations suggest that there is an important demand for these types of interventions among the overall population in project sites. On average, participants were involved in a high number of interventions and adopters applied many of them. All of the innovations adopted were rated at least as “useful” by at least 50 percent of the adopting households.

Regression results showing the coefficients that relate to the three hypotheses proposed to assess the success of a project (Table 3) provide evidence that: (1) farmer *ex ante* participation in project interventions is associated with the application of a higher number of innovations in all projects; (2) in three of the projects the application of an increasing number of innovations is associated with growing a larger amount of crop diversity; and (3) in three of the projects farmers obtained additional benefits from the crop diversity they grow, in terms of higher quantities of the target crops consumed and sold from their production in the case of the projects in Bolivia and a higher perception of life satisfaction among farmers in the project in Ecuador. These results already take into account and correct for other confounding variables (full regression results in Table S3).

Discussion

Results show a plausible link between participation in project interventions, the application of innovations provided by them and crop diversity, and between diversity and household benefits, at least in three of the projects studied. Testing all three hypotheses simultaneously provides robust evidence of the success of a project because it imposes more stringent conditions for their acceptance and reduces the margin of error involve in the estimation. Successful project then can generate additional benefits from maintaining crop diversity on farm that farmers can capture directly. This not only creates additional incentives for farmers to continue to engage in processes that generate novel genetic variation of potential value to society, but also contributes to make these processes acceptable to these farmers and society by aligning their short-term private interests with society’s long-term public ones.

Clearly our empirical approach has limitations since all projects were studied after their completion and neither baseline information nor *a priori* controls exist, limiting the counterfactual that could be used, which is not an uncommon problem for studies that attempt to demonstrate the value of conservation projects (Lewis et al. 2011). However, there are other lines of evidence that support

our results. Most of the interventions would not have been available to farmers without the projects in the study communities and the levels of participation and application of innovations provided by project interventions were very high, consistent with an effect due to the projects. In spite of high participation and application of project innovations, in at least two projects in Peru there was no evidence of an effect on crop diversity, nor on household benefits. This could be because in fact there was no effect or because of low statistical power due to small sample size and limited variation in the relevant data.

The challenge of generating defensible evidence from imperfect data is common to development projects in rural areas—including on-farm conservation projects that include a strong development component—and can stem from a lack of interest, a lack of funding or of expertise on the part of project implementers for the design and collection of appropriate data necessary to generate evidence of project outcomes. Obviously, project implementers are interested in the success of their projects, but their views and measures of what constitutes success can be very different from what scientists, donors and policy makers may consider valid evidence in this respect. To the extent that public benefits are invoked to support projects and public funds are invested, there is a need to strengthen the generation of data and defensible evidence. The need for evaluating the success of actions to support conservation has also been identified as important for conservation strategies of wild biodiversity (Brooks *et al*. 2006) and particularly for interventions to foster livelihood improvement among human populations that interact with wild biodiversity as a means of creating incentives for its conservation (Lewis et al. 2011).

All projects implemented a basket of interventions with different aims that addressed different aspects of the production, consumption and marketing of these native crop species, providing diverse and relevant “options” to smallholders in quite marginal conditions. These options enhance the value of what they already have. It is not possible and probably not even desirable to establish exactly which interventions may have been more influential than others, since the value of a basket of interventions is to provide diverse choices, some of which maybe more meaningful to some farmers than others depending on their specific contexts and circumstances. This has important implications for scaling-up, since by definition on-farm conservation relies on maintaining and addressing diversity. So scaling up cannot be done by homogenization, i.e., trying to apply the same interventions and associated innovations over large areas or groups of farmers, but rather by a process of systematic contextualization, in which diverse options are assembled and targeted to fit different contexts, letting users choose which one fits best under their circumstances.

A problem faced by on-farm conservation efforts, both in terms of studying de facto conservation as well as implementing projects to support it, is that they are usually fragmented, done in isolation, with limited capacity to learn and share information beyond their sphere of influence, both in terms of what works, similarities and differences, as well as about the genetic variation that is maintained by farmers involved and its evolution. For on-farm conservation to become more globally valuable a more concerted effort should take place that addresses these problems. This may entail the development of some sort of global learning and information system that monitors de facto on-farm conservation and the implementation and outcomes of related projects, particularly collecting and analyzing information on crop adaptation and evolution, that enables farmers, practitioners, scientists, donors and policy-makers to identify practices, knowledge and germplasm that can be

used in different places and situations as change happens. Such a system should be quite decentralized and open, and will require the development of new sets of tools and methods to monitor evolution and adaptation.

A crucial aspect of on-farm conservation, mentioned but not addressed explicitly in this paper, was the functional relationship between the amount of crop diversity present in an agricultural system and the evolutionary services it generates (the fourth hypothesis), which is unknown. This relationship is likely scale-dependent, with the processes that underpin it and the benefits generated varying across different scales from the crop population to the field, the farm, the community, the landscape, the region and the world. Linkages across scales may be crucial for understanding this relationship. For example, there is an emerging consensus about the functional relationship that links biodiversity and ecosystem functioning and underlines the importance of evolutionary processes for the ecosystem consequences of biodiversity loss (Cardinale et al. 2012), which suggests that in the future the relationship between crop diversity and evolutionary services can be elucidated.

On-farm conservation can and should play an important role in the pursuit of resilient agricultural and food systems. Projects that support it can create a virtuous cycle in which farmers who maintain this diversity benefit from it, in turn creating incentives to continue to maintain it in their fields, and farms, making the processes sustainable and keeping its option value for society. This study has shown that there is evidence that this can happen and that maintaining crop diversity can contribute to the generation of positive livelihood outcomes.

In conclusion, the crop biodiversity and the farmers who maintain it in centers of crop diversity are not anachronistic remnants of the past but key contributors to society's capacity to adapt and respond to future—and sometimes unpredictable challenges associated with global change --but they need to be supported and nurtured. On-farm conservation projects can play an important role in this process, but they need to be assessed and linked, to allow learning and sharing of information, knowledge and germplasm in order to realize their value.

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Table 1. Indicators of crop diversity in the six studied projects (numbers in bold indicate target crops for the relevant project)

	Ecuador	Peru		Bolivia	
Indicator[1]	A[2]	B	C	D	E
Total number of crops reported	137[3]	11	2	13	13
Mean number of crops/hh	**36**	2.2	1	3.7	3.4
Mean number of varieties/crop/hh	**1.2**	7.3	11.9	15.9	11.9
Quinoa (*Chenopodium quinoa*)					
Farmers planting (%)	22.7			**76.5**	**88.2**
Mean number of varieties/hh				**1.8**	**2.4**
Cañahua (*Chenopodium pallidicaule*)					
Farmers planting (%)				**51.9**	**4.3**
Mean number of varieties/hh				**1.7**	**2.3**
Lupinus (*Lupinus mutabilis*)	18.2				
Farmers planting (%)					
Mean number of varieties/hh					
Oca (*Oxalis tuberosa*)					
Farmers planting (%)	6.3	**40**		16.7	16.8
Mean number of varieties/hh		**1.9**		3.2	2.4
Ulluco *(Ullucus tuberosus*)	6.8				
Farmers planting (%)		**57.5**		2.5	2.5
Mean number of varieties/hh		**2.1**		2.3	2
Maswa (*Tropaeolum tuberosum*)					
Farmers planting (%)	2.8	**19.2**		1.2	2.5
Mean number of varieties/hh		**1.5**		2	2.5
Potatoes (*Solanum tuberosum*)					
Farmers planting (%)	52.3	**95**	**98.4**	99.4	97.5
Mean number of varieties/hh		**3.5**	**11.9**	11.1	7.2

[1] Means were calculated for only for those who grow the crop

[2] Data on infra-specific diversity not presented due to difficulties in calculating them by specific crop

[3] These data refer not only to crops, but include not only different cultivated species, but also fruit trees, herbs from home gardens and agroforestry species, as well as some species collected from the wild.

Table 2. Participation in project interventions and adoption of innovations provided

	Ecuador	Peru		Bolivia	
Project	A	B	C	D	E
No. interventions/project	22	13	15	16	13
Sample size	176	120	129	162	161
Ex-ante rate of participation (%)	55	37	31	35	16
Observed rate of participation (%)	66	88	98	53	45
Mean number of interventions participated	7	7.7	6.1	8	7.9
Rate of adoption among participants (%)	150	90	90	88	72
Mean number of interventions adopted	5.4	4.9	3.7	3.96	3.85
Median rating of usefulness of intervention	4.3	4.1	4	4	4

Table 3. Summary of regression results associated with hypotheses of project success

	Outcomes		
	Adoption	**Native Crop Diversity**	**Household Benefits**
		Project A	
Ex ante participation	**3.293** ***		
Adoption		**0.184** ***	
Native Crop Diversity			**0.536** *
		Project B	
Ex ante participation	**1.612** **		
Adoption		0.166	
Native Crop Diversity			-2.858
		Project C	
Ex ante participation	**0.860**		
Adoption		0.322	
Native Crop Diversity			0.136
		Project D&E[1]	
Ex ante participation	**1.982** ***		
Adoption		**0.038** ***	
Native Crop Diversity			**0.387** *

Note: *, **, ***, significant at the .05, .01, .001 level respectively

[1] The two projects in Bolivia, D&E, were merged because they included very similar interventions, were implemented by the same institution, PROINPA. The dummy variables referring to the regions capture the differences between both projects.

SUPPLEMENTAL INFORMATION

Table S1. Projects studied

ID	Country	Project name	Target species	Implementing agency	Donor
A	Ecuador	Promotion of Andean Crops for Rural Development in Ecuador	Multiple species	UNORCAC	US Department of Agriculture
B	Peru	Biodiversity of Andean Tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands	Oca (*Oxalis tuberosa* Mol.) Ulluco (*Ullucus tuberosus* Caldas) Maswa (*Tropaeolum tuberosum* R.&P.) Potatoes (*Solanum tuberosum* Linn.)	CRIBA	McKnight Foundation
C	Peru	Improved production of native potatoes in the Andean Highlands of Peru	Potatoes *(Solanum tuberosum* Linn.*)*	ITDG	McKnight Foundation
D	Bolivia	Enhancing the Contribution of Neglected and Underutilized Crops to Food Security and to Incomes of the Rural Poor	Quinoa *(Chenopodium quinoa* Willd.) Cañahua (*Chenopodium pallidicaule* Allen*)*	Bioversity Int. & PROINPA	International Fund for Agricultural Development
E	Bolivia	National Genetic Resources System for Food and Agriculture", Andean Grains	Quinoa *(Chenopodium quinoa* Willd) Canahua (*Chenopodium pallidicaule* Allen)	PROINPA	Gov't of Bolivia

Table S2. On-farm conservation projects identified in the High Andes of Ecuador, Peru and Bolivia

	Project Title	Main Donor	Starting	Ending
1	Proyecto Integral Las Huaconas (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	SDC (Suisse Agency for Development and Cooperation)	1993	2003
2	Proyecto Integral Candelaria (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	SDC (Suisse Agency for Development and Cooperation)	1993	2003
3	Proyecto Integral Altiplano (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	SDC (Suisse Agency for Development and Cooperation)	1993	2003
4	Promoción de Cultivos Andinos: Desarrollo de Agroindustrias y Mercados para la Arracacha (Collaborative Programme for the Conservation and use of Biodiversity of Andean Roots and Tuber Crops (RTAs))	SDC (Suisse Agency for Development and Cooperation)	1999	2001
5	Native Potato: improved production of native potatoes in the Andean highlands of Peru	McKnight Foundation	2005	2009
6	Biodiversity of Andean tubers: strengthening the On-farm Conservation and Food Security of Andean Tubers in the Fragile Ecosystems of the Southern Peruvian Highlands	McKnight Foundation	1995 2001	1999 2005
7	Uso, manejo y conservación in situ de tres variedades locales de papa en el Austro Ecuatoriano	UNDP	2000	2002
8	Biodiversity and soil conservation, the motor for development of Chopcca communities in Huancavelica, Peru	McKnight Foundation	2005	2009
9	Potato moth: biopesticide development and diffusion of potato moths. Integrated management to strengthen food security in the Ecuadorian Andes	McKnight Foundation	2005	2009
10	Uso sostenible de la biodiversidad de raíces andinas en el sub trópico del municipio de Colomi, provincia Chapare – Cochabamba	Fundacion PUMA via Iniciativa para la America (EIA)	2005	2009
11	Enhancing the contribution of neglected and underutilized species to food security and to incomes of the rural poor'	IFAD	2001 2007	2003 2009
12	Manejo, Conservación y Uso Sostenible de los Recursos Genéticos de Granos Altoandinos, en el marco del SINARGEAA	Bolivian Government - Sistema Boliviano de Tecnología Agropecuaria (SIBTA)	2003	2008
13	Desarrollo Sostenible de Quinua Orgánica en el Perú	Scanagri/NIRAS	2003	2005

	Project Title	Main Donor	Starting	Ending
14	Sustainable production of quinoa: a neglected food crop in the Andean region	McKnight Foundation	2001 2006	2005 2010
15	Lupin/ Quinoa: Sustainable production systems to guarantee food security in impoverished communities in the province of Cotopaxi, Ecuador	McKnight Foundation	2005	2009
16	Conservación complementaria *ex situ - in situ* de especies silvestres de quinoa y cañihua en Bolivia	Global Environmental Facility (GEF)	2005	2009
17	Programa de apoyo a la cadena quinoa altiplano sur	Dutch Embassy	2005	2008
18	Green manure and legumes: integrating agronomic and health research for improving the production of food and diets in marginal areas of Northern Potosi	McKnight Foundation	2005	2009
19	Cover agriculture: a farmer-led research initiative on the application of cover agriculture principles in the Andean highlands (COBERAGRI)	McKnight Foundation	2005	2009
20	In-Situ Conservation of Native Cultivars and Their Wild Relatives	United nations Development Programme (UNDP)- Global Environmental Facility (GEF) - Small Grant Programme	2005	2009
21	Seguimiento y ampliación de la rehabilitación de la biodiversidad en fincas ganaderas en el Noroccidente de Pichincha	Global Environmental Facility (GEF)	1998	2000
22	Conservation of Biodiversity in Pastaza	Global Environmental Facility (GEF) Co-financing	2003	2005
23	Conservacion complementaria y uso sostenible de cultivos subutilizados en Ecuador, rescate, promocion y uso de recursos fitogeneticos interandinos de Ecuador	USDA	2002 2006	2005 2008
24	Conservación y manejo de la agrobiodiversidad en la cordillera de El Cóndor	SDC (Suisse Agency for Development and Cooperation)	2004	2008
25	Seed systems. The biological foundation of food security in the Andes	McKnight Foundation	2005	2009
26	Removing Obstacles to Direct Private-Sector Participation in In-situ Biodiversity Conservation	Global Environmental Facility (GEF)	2002	2005

Table S3. : Key socioeconomic characteristics of studied farmers and households

	Ecuador	Peru		Bolivia	
Indicator by household	A	B	C	D	E
Total landholding (ha)	0.7	2.3	2.4	1.8	0.6
Language commonly spoken (%)					
Spanish	35.8	24.2	31	43.2	47.8
Quechua	34.1	75.8	69	0	0
Aymara	0	0	0	56.8	52.2
Sex of head (female)	32.4	5	10.9	19.8	13.7
Age of head (years)	47.6	43.2	45	63.1	55.7
Education of head (years)	2.9	3	3.1	2.8	3
Family size (number)	5.2	4.4	4.2	4.1	4.6
Household with migrants (%)	0	6.7	11.6	16.7	16.2
Mean sources of income outside own agriculture	2.5	0.8	0.8	0.8	0.7

Table S3. Detailed results of the three-stage regression

	Ecuador	Peru		Bolivia
	A	B	C	D&E[1]
Adoption				
Ex ante participation[2]	**3.293****	**1.612*****	**0.860***	**1.982****
Number of plots	**0.476*****	0.159	**0.252*****	**0.191***
Spanish	-0.551	0.378	-0.336	0.103
Sex household head	-0.058	-1.372	0.423	0.001
Age head of household	-0.017	0.022	-0.018	-0.009
Education head of household	0.088	**0.251***	-0.090	0.069
Migration		-0.107	-0.234	-0.110
Labor availability	-0.009	0.005	-0.001	0.002
Landholdings	0.051	0.011	0.014	-0.000
Wealth	**0.493*****	0.136	0.217	0.150
Organizations	0.093	-0.052	**0.630*****	**0.390****
Sources of income	0.043	0.143	0.047	0.067
Region 1	0.338	**-2.692*****	-0.067	-0.350
Region 2	**1.379***	**-1.930****	-0.533	-0.271
Region 3	-0.122	**-1.813****	0.470	**-0.969****
Region 4	0.149	-1.064		
Constant	1.681	1.368	**2.186***	0.199
Native Crop Diversity				
Adoption	**0.184******	**0.166***	**0.322***	**0.038******
Number of plots	-0.038	-0.001	-0.047	0.007
Spanish	**-0.296****	**-0.413****	0.225	-0.020
Sex household head	**0.306****	0.286	-0.054	0.007
Age head of household	0.004	0.004	0.002	-0.001
Education head of household	0.012	-0.047	0.005	-0.004
Migration		0.194	0.070	-0.009
Labor availability	0.003	0.003	0.004	0.001
Landholdings	0.041	0.027	-0.006	0.000
Wealth	**0.106****	0.065	-0.087	0.004
Organizations	0.096	-0.115	**-0.236***	**0.049******
Sources of income	-0.076	-0.082	-0.092	-0.005
Region 1	**-0.354****	0.252	-0.183	**-0.168******
Region 2	**-0.417***	-0.248	-0.161	**-0.120******
Region 3	**-0.398****	0.036	-0.148	**-0.090****
Region 4	-0.153	-0.100		
Constant	**-1.528******	**-0.970***	-0.597	0.010
Household Benefits				
Native Crop Diversity	**0.536****	-2.858	0.136	**386.973****
Number of plots	0.08	0.211	0.397	3.637
Spanish	0.122	-0.856	0.568	14.614
Sex household head	**-0.294***	-0.694	-1.214	-19.184
Age head of household	**-0.017******	0.022	0.110	**1.195*****
Education head of household	-0.034	0.092	**1.821****	0.432
Migration		0.414	-0.281	2.559
Labor availability	-0.004	0.037*	0.089	0.278
Landholdings	-0.015	0.157	0.290	0.001**
Wealth	0.082	0.173	-0.554	-0.943
Organizations	-0.145	-0.307	**2.855****	-14.189

Sources of income	0.011	**-0.619****	**-3.041***	**16.447****
Region 1	-0.028	-0.862	2.808	14.032
Region 2	**-0.552***	-0.964	-8.064	35.946
Region 3	0.332	-0.962	-6.736	12.153
Region 4	0.369	-1.045		
Constant	**1.048***	-1.807	3.577	-66.212

Note: *, **, ***, ****, significant at the .10, .05, .01, .001 levels respectively

[1] The two projects in Bolivia, D&E, were merged because they included very similar interventions, were implemented by the same institution, PROINPA. The dummy variables referring to the regions capture the differences between both projects.